

# CONCRETE AND CONSTRUCTIONAL ENGINEERING

INCLUDING PRESTRESSED CONCRETE

MAY, 1952.



Vol. XLVII, No. 5

FORTY-SEVENTH YEAR OF PUBLICATION

PRICE 1s. 6d.

ANNUAL SUBSCRIPTION 16s., POST FREE. 53-90 in Canada and U.S.A.

## LEADING CONTENTS

	PAGE
Methods of Testing Concrete . . . . .	131
Cooling-water Intake Structure at an Oil Refinery. <i>By</i> <i>B. H. Broadbent, B.Sc.(Eng.)</i> . . . . .	133
The Design of Simple and Composite Prestressed Concrete Beams. <i>By E. W. Bennett, M.Sc.</i> . . . . .	141
Book Reviews . . . . .	147
Factory at Brynmawr, South Wales. . . . .	151
Consolidation of Concrete in Roads and Runways . . . . .	155
A German Method of Shuttering . . . . .	157

No. 534.

ISSUED MONTHLY

Registered for  
Canadian Magazine Post

## BOOKS ON CONCRETE

For catalogue of "Concrete Series" books on  
concrete and allied subjects, send a postcard to:

CONCRETE PUBLICATIONS LTD., 14 DARTMOUTH ST., LONDON, S.W.1



*For over 60 years*

this trade mark has stood for speed and  
strength in reinforced concrete work.

# DRAGON

(Brand)

## PORTLAND CEMENT

*Supplied by*

THE SOUTH WALES PORTLAND CEMENT & LIME CO. LTD.  
PENARTH, SOUTH WALES

Telephone : Penarth 300

Telegrams : "Cement, Penarth"

# Burton's

## TUBULAR STEEL TRENCH STRUTS

(ADJUSTABLE)



REGISTERED



TRADE MARK



### OUTSTANDING ADVANTAGES

1.—Save at least 80% labour by eliminating the old-fashioned system of cutting, wedging and nailing timber strutting; no waste of timber.

2.—Fixed by one man in one minute.

3.—Being steel complete, they are practically everlasting and can be used over and over again indefinitely.

4.—Take up very little store space and very compact for transport.

5.—No loose parts which can be lost, so they are always ready for work.

### IN THREE SIZES

Size No.	Length		Approx. Weight
	Closed	Expanded	
1.	1' 6"	2' 3"	14 lb.
2.	2' 4"	3' 6½"	19 lb.
3.	3' 4"	5' 6"	24 lb.

## Burton's Patent Solid Dropforged Steel Scaffolding Fittings

## THE LONDON & MIDLAND STEEL SCAFFOLDING CO., LTD.

ST. LUKE'S WORKS, OLD HILL, STAFFORDSHIRE

Telegrams: DUBELGRIP, CRADLEY HEATH.

Telephone: CRADLEY HEATH 6237/8

London Offices: BURWOOD HOUSE, CAXTON STREET, S.W.1

Telephone: Abbey 6483/4.

Telegrams: Dubelgrip, Sowest, London



FACTORY WORK IN COURSE OF CONSTRUCTION

# YORKSHIRE HENNEBIQUE

FERRO - CONCRETE SPECIALISTS  
SINCE 1904

HEAD OFFICE : VIADUCT WORKS, KIRKSTALL ROAD, LEEDS, 4

Telephone : Leeds 20687-8-9

Telegrams : Ferro, Leeds

BRANCH OFFICES : 30, WINCOLMLEE, HULL. Telephone : Hull 33501

SCOTLAND : ALNESS, ROSS-SHIRE. Telephone : Alness 287

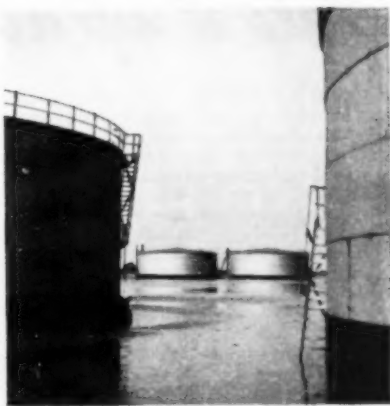
---



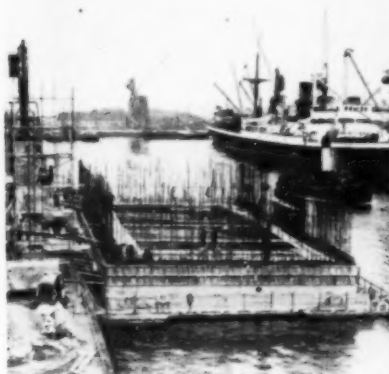
## Oil Refinery Construction at Coryton



*Placing concrete for storage tank bases*



*Floating 100-ton oil tanks to new positions*



*Water intake works constructed at Tilbury and floated to Coryton*



*The refinery site is below high water level of the Thames*

Civil engineering and building work is in progress at the new refinery for Vacuum Oil Company Limited at Coryton in conjunction with the Lummus Company Limited. This project on the Essex side of the Thames involves considerable construction work in heavy foundations, roads, drainage, and a water intake works and jetty.

**LAING**

**Contractors for every class of Building and Civil Engineering work at home and overseas**

*John Laing and Son Limited, London, Carlisle, Johannesburg, Lusaka. Established in 1848*

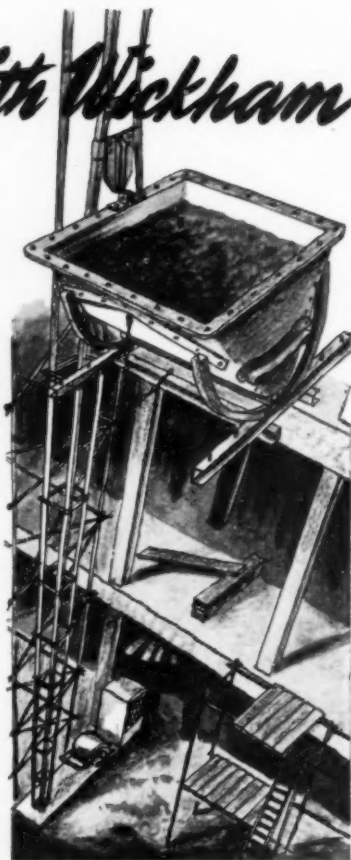
## *take it up with Wickham*

WICKHAM Builders' Hoists, all models, include quick fitting Tower Masts which take substantially less time to erect. The Mast sections are designed to butt on to each other and so rabbeted as to be automatically self-aligning. Sections are held together by six bolts only, no fish plates being required. The Power unit is totally enclosed in a steel housing affording complete protection. All Wickham Friction Winches are fitted with self-aligning ball and/or roller bearings, giving longer life and lower maintenance costs. All Wickham Builders' Hoists are fitted with an Automatic platform control which increases the life of the wire bond and prevents crashed platforms.

Leading Contractors on the Festival of Britain sites made extensive use of WICKHAM BUILDERS' HOISTS

### WICKHAM PRODUCTS

Builders' Hoists (Mobile and Static), Passenger Hoists, Concrete Elevators, Diaphragm Pumps, Power Winches, Portable Winches, Brick Barrows, Safety Gates



*Please write to us for interesting literature and the name of our agent in your area.*

TAKE IT



UP WITH

# *Wickham*

WICKHAM  
ENGINEERING CO. LTD.

(Dept. 4) 34 VICTORIA ST., LONDON, S.W.1. Phone: ABBEY 5967-8

Grams: Wicamite Sowest London



The symbol of leadership  
in the development  
and manufacture of  
*Prestressed Precast Concrete*  
in Great Britain



**CONCRETE DEVELOPMENT CO. LTD**

Office and Works:  
Iver, Bucks  
Telephone: Iver 809

London Office:  
1 Queen Anne's Gate, SW1  
Telephone: Whitehall 3111

# ROOF WATERPROOFING AND PROTECTION WITH

## **EVODE** **PASTES**

### **The 1952 Set-up**

- 1** The brake on new construction gives added importance to the need for vigilantly conserving roofed buildings. The modern practice is to use the Evode Insulating Paste technique which ensures an efficient job with less labour.
- 2** There is no reason to anticipate a shortage of Evode Pastes. How about the labour side?
- 3** Hundreds of tons of these insulating pastes have been supplied to British Railways, the London Boroughs and other clients for application with their own labour. The technique is quickly grasped. We supply "foolproof" guides for the use of

foremen in charge of work. Our expert demonstrators are readily available to show how to new users. Own-labour use of Evode Pastes will be the trend in 1952.

- 4** Millions of square feet of concrete and asphalt roofs, corrugated iron and corrugated asbestos have been waterproofed by the Evode Contracts Department. It will continue giving efficient service but our 1952 policy will be to train a "float" of expert labour.

*Evode has a big job in 1952 and will do it by the resilient application of technique to practice. Never hesitate to ask for advice. Phone, wire or write and we'll be with you.*

**EVODE LIMITED · GLOVER STREET · STAFFORD**

Telephone: 1590/1/2

Telegrams: Evode Stafford

---

# DOUGLAS

---



*Trostre Works, Llanelli, for the Steel Company of Wales.  
L. G. Mouchel & Partners, Ltd., Consulting Engineers.*

---

**CIVIL ENGINEERING      BUILDING**  
**SITE INVESTIGATIONS**  
**REINFORCED AND PRESTRESSED CONCRETE**

---

**ROBERT M. DOUGLAS (CONTRACTORS) LTD.**  
395 GEORGE RD., BIRMINGHAM, 23. AND BRIDGE RD., WAUNARLWYDD, nr. SWANSEA.

---

# *use the* **A.B.** **SERVICE** **for concrete work**

## **SHUTTER PANELS**

All sizes and types

## **ADJUSTABLE SHORES**

for floor and beam support

## **ADJUSTABLE CENTRE FORMS**

for floor support

## **SHUTTERLOCK WALING CLIPS**

For bracing with scaffold tube and locking the panels together, eliminating nuts and bolts in shuttering. Tremendous saving in erecting and striking costs

## **COLUMN CLAMPS : BEAM CLAMPS**

## **ROAD FORMS : TRENCH STRUTS**

We also design and manufacture Steel Moulds for Floor Beams, Piles, Railway Sleepers and all other precast concrete products

*Let us solve your problems*

**A. B. MOULD & CONSTRUCTION CO., LTD.**

92 WHITEHORSE ROAD

CROYDON

SURREY

Telephone : Thornton Heath 4947.

Telegrams : Abmould, Croydon.



## When the Shuttering is

# RAPID METAL FORMWORK



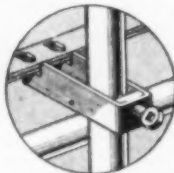
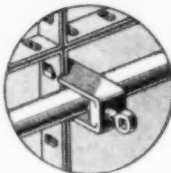
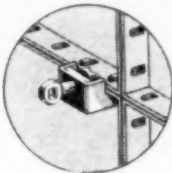
*Rapid Metal Formwork as used on Sludge Tank Boundary Walling for the Prince of Wales Dry Dock Co. (Swansea) Ltd. Contractors: Frank R. Freeman Ltd., London*

# it's a much better job!

Why? Because the patent pressed steel arris panels guarantee a smooth, uniform surface to the concrete.

No fins. No rubbing down. Further, **RAPID METAL FORMWORK** can be erected or struck easily and quickly by semi-skilled labour. No special tools are required. This means that time, material and labour are saved. Costs are reduced. No wonder **RAPID METAL FORMWORK** is in such great demand for every type of in situ concrete construction.

**RAPID METAL FORMWORK** is made up from four basic components— $\frac{1}{2}$ " steel straight and corner panels, channel posts and clamps. The arris panels and channels (which are available in a variety of sizes) have precision-slotted boundary flanges to take the 3 types of patent clamps.



### B.I.F. Castle Bromwich

You are cordially invited  
to our Stand (Outside) No. 1212/1212.  
Telephone: FAIR 611



Our expert technicians are ever at the service of the Civil Engineering and Building industries, to collaborate and demonstrate the many advantages of **RAPID METAL FORMWORK**. Post coupon for illustrated brochure and full details of sale or hire terms, to Rapid Metal Developments Ltd., 209, Walsall Road, Perry Barr, Birmingham, 22b.

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

## RAPID METAL FORMWORK

Supplied by

**RAPID METAL DEVELOPMENTS LTD.**

209, Walsall Rd., Perry Barr, Birmingham, 22b.  
Telephone: BI Rehfields 6021

# FOUNDATIONS

*The Cementation Company is able to tender for any kind of work connected with foundations of buildings or industrial plant and machinery by piling, cementation, or chemical consolidation, and the carrying out of remedial measures to damaged or deteriorating structures by cementation or guniting.*

*Cast in situ piles can be put down to great depth with a minimum of headroom and very little vibration, with designed bearing capacity.*

## WATER LOSSES

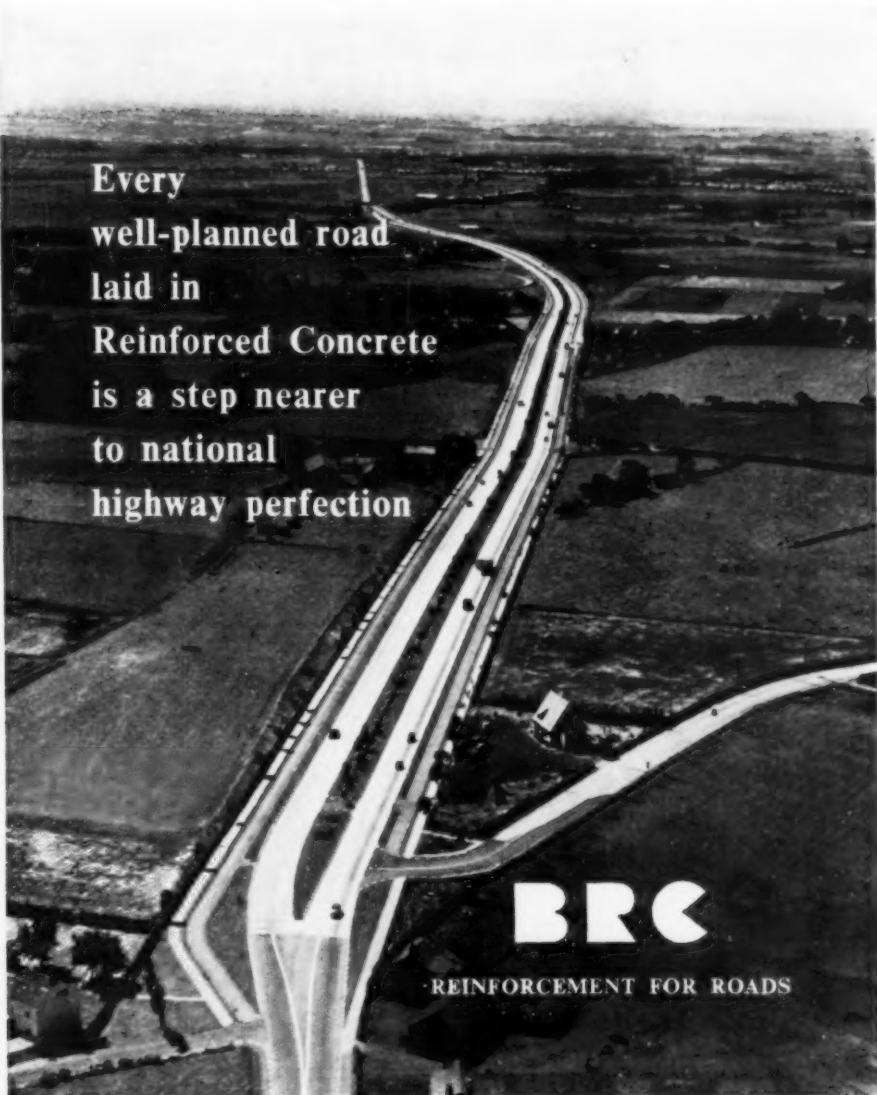
**OUR WIDE EXPERIENCE  
IS AT YOUR DISPOSAL**

FOR NEARLY HALF A CENTURY WE HAVE, BY ONE OR MORE OF OUR PROCESSES, SUCCESSFULLY PREVENTED LEAKAGE OF WATER THROUGH, UNDER AND AROUND DAMS, FROM SERVICE AND IMPOUNDING RESERVOIRS, FILTER BEDS, DRAW-OFF TUNNELS AND OTHER ANCILLARY WORKS.

**THE CEMENTATION  
CO. LTD.** Telephone Don 5477-4-BENTLEY WORKS, DONCASTER.

LONDON OFFICE : 39, VICTORIA STREET, S.W.1.

TELEPHONE : ABBEY 5726-7-8.



Every  
well-planned road  
laid in  
Reinforced Concrete  
is a step nearer  
to national  
highway perfection

**BRC**

REINFORCEMENT FOR ROADS

*Maghull By-pass (Lancashire County Council)*

**THE BRITISH REINFORCED CONCRETE ENGINEERING CO. LTD., STAFFORD**  
*London, Birmingham, Bristol, Leeds, Leicester, Manchester, Newcastle, Cardiff, Glasgow, Dublin, Belfast*

# SUPER CEMENT

**'SUBMARINE BRAND'**

THE TANNO-CATALYSED PORTLAND CEMENT

**SAVES TIME**

**SAVES TROUBLE**

NATURALLY WATERPROOF, CONTAINS NO WATER REPELLENT MATERIAL

**Uses:—**

**For CONCRETE**

Provides a CONCRETE of great strength at early dates and impervious to water, oil, etc., without any form of surface coating.

**For PAVING**

Produces a hard wearing PAVING, dustless and proof against penetration by water, etc.

**For RENDERING**

Supplies an impenetrable RENDERING of such adhesive power that a 1" thickness will resist an outside pressure of at least a 20' head of water.

**For SLURRY (as paint)**

Makes a perfectly watertight covering to brick or breeze concrete walls at very small cost, and also provides the best watertight undercoat to coloured finishes.

Technical Information is available to users.

*Used in 1914-1918 and still used by:*

Air Ministry, War Office, Admiralty, Ministry of Works, Ministry of Supply, etc.

**SUPER CEMENT LTD.,**

29 TAVISTOCK SQUARE, Phone: Euston 1808  
LONDON, W.C.1

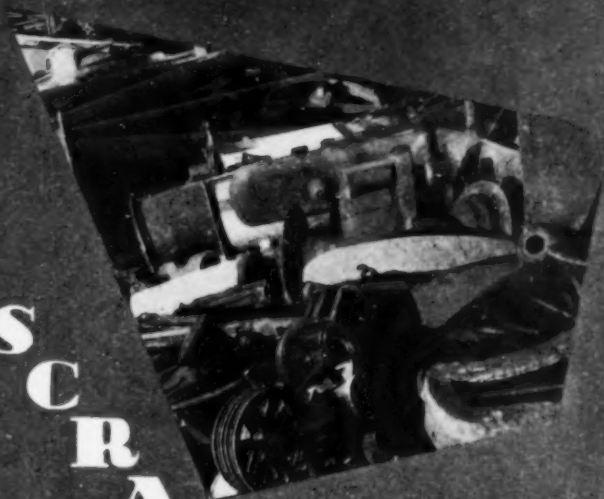
**CONCRETE  
PROOFING  
Co. LTD.**

**GUNITITE  
SPECIALISTS**

Expert advice and schemes submitted for gunitite work of every kind. Complete information on the various uses of gunitite will be gladly sent on request.

100, Victoria Street, Westminster, S.W.1 Telephone: VICTORIA 7877 and 8275

NO  
SCRAP  
NO  
STEEL



●  
SEARCH OUT *YOUR* SCRAP  
& OBSOLETE PLANT *TO-DAY!*

 **COLVILLES** LTD 

COLVILLES LTD 195 WEST GEORGE STREET GLASGOW C.2

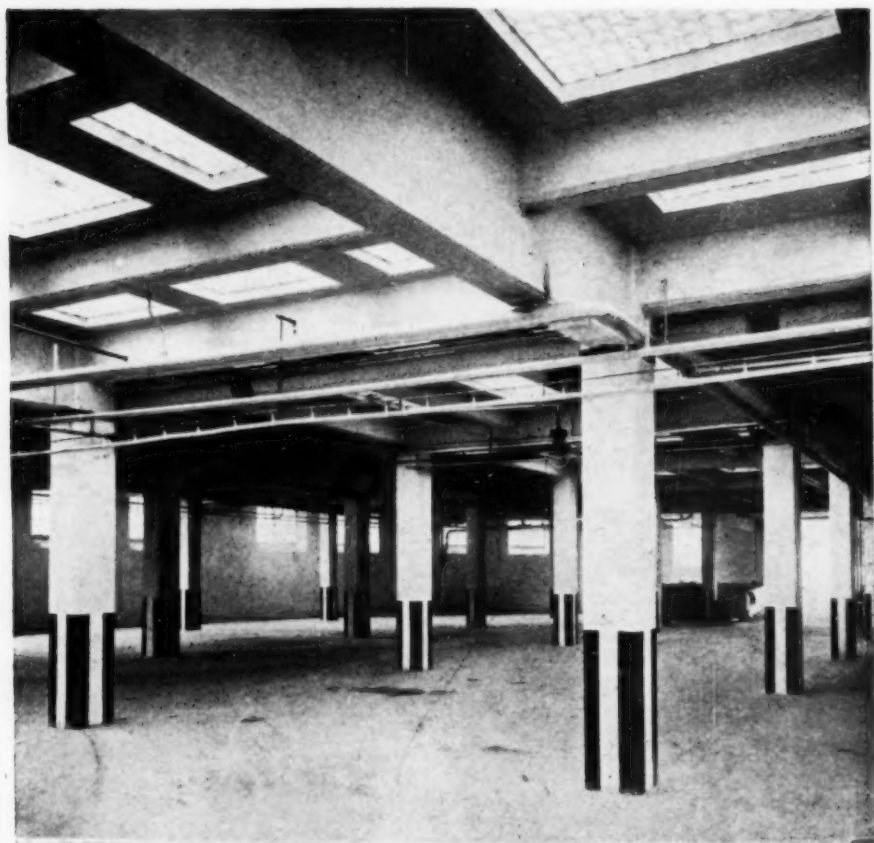
---

---

OVERHEAD DAYLIGHT

---

---



## 'CRETE-O-LUX' LIGHTS

Haywards 'Crete-o-Lux' Lights, of reinforced concrete construction, are purpose-made and precast (unless otherwise required) for maximum efficiency and dependability. These Lights meet every need of present-day practice, being specially designed for Pavements, Roadways, Floors, Stallboards, Roofs, Domes, Canopies, Lanterns, Windows, etc. Their use ensures good appearance and the best possible transmission of light.

### HAYWARDS LTD

UNION STREET, BOROUGH, LONDON, S.E.1

---

---

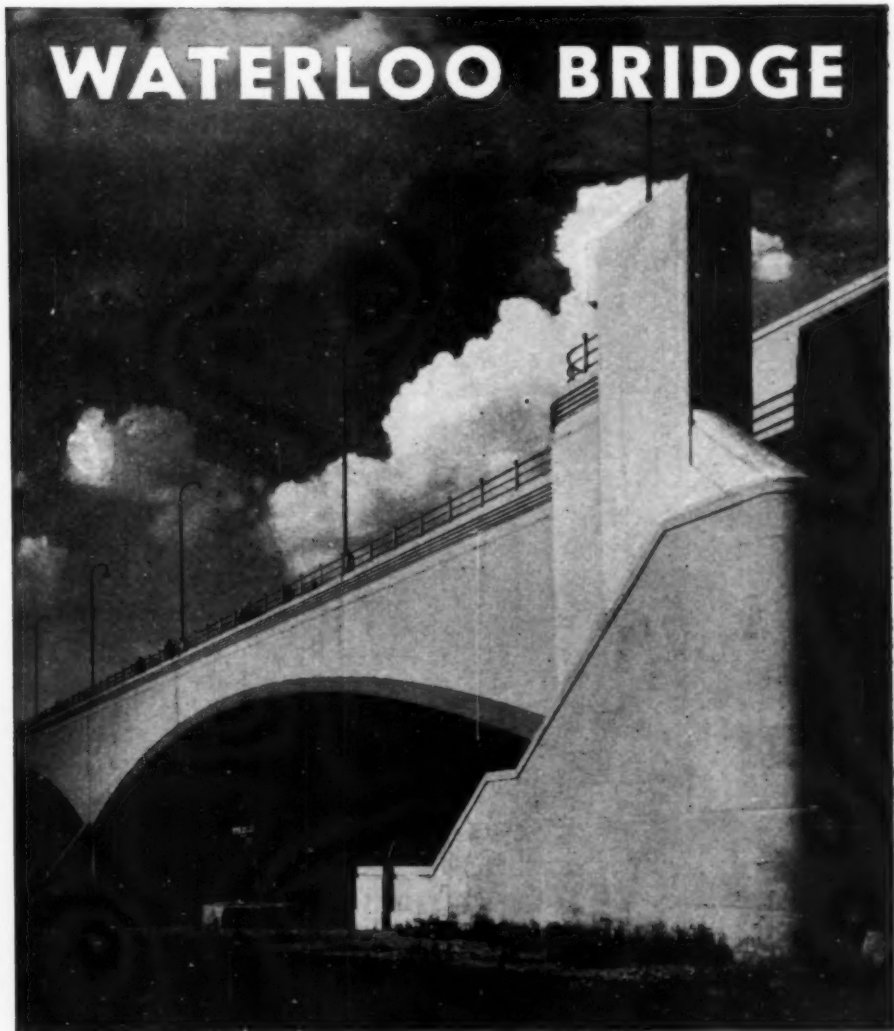
TELEPHONE : WATERLOO 6035 (PVTE. BRCH. EXCHANGE)

---

---



# WATERLOO BRIDGE



APPOINTED ARCHITECT

SIR GILES GILBERT SCOTT, R.A.

APPOINTED ENGINEERS

RENDEL, PALMER & TRITTON

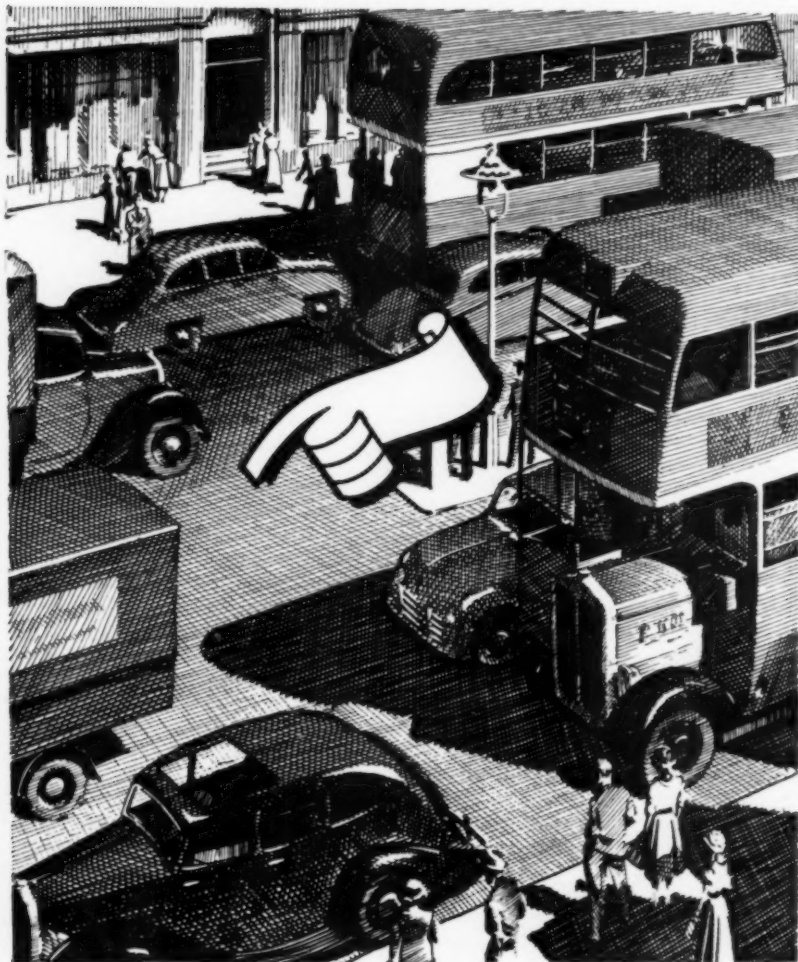
CHIEF ENGINEER TO THE COUNCIL

SIR T. PEIRSON FRANK, M.INST.C.E.

## PETER LIND & CO LTD

STRATTON HOUSE, STRATTON STREET, PICCADILLY, W.1

TELEPHONE: GROSVENOR 4601



Let there be any hidden weakness in concrete on the modern highway, and pounding traffic will soon reveal it. Authorities and contractors alike are discovering that sound setting and long life for concrete is best ensured with an underlay of impermeable **IBECO**. Makes for faster work, lower cost, and maximum strength.

**IBECO**



**COMPLETELY WATERPROOF CONCRETING PAPER**

MADE BY C. DAVIDSON & SONS LTD • MUGIE MOSS • ABERDEENSHIRE

When it's a question of  
**COLOURED CONCRETE**  
 always specify

## PROCTORIAL COLOURS

Permanent non-fading colours for concrete, cement, cast stone, concrete tiles, magnesium oxy-chloride, and all types of flooring.

Our range of "PROCTORIAL" BRAND CEMENT COLOURS has been developed during 50 years' experience of the requirements of users, and includes light, middle and deep shades of

- Reds, Yellows and Browns, Marigold, Blacks, Green, and Blue. Literature, samples and prices from:

**PROCTER, JOHNSON & CO. LTD.**

BANK STREET, CLAYTON, MANCHESTER

Telephone: East 1611 (2 lines)



**Essential to all users  
of concrete!**

the

# ACROW

## WIGMORE CONSISTOMETER

*A really practical machine for quickly  
and accurately measuring WORKABILITY*

Write now for  
full particulars to:-  
**ACROW**  
(Engineers) Ltd.

{ South Wharf, Paddington, London, W.2 (Ambassador 3456)  
130 Coventry Drive, Glasgow, E.1. ... (Bridgeton 10411)  
22-24 City Road, Bristol, 2 ..... (Bristol 24595)  
West Stanley Street, Manchester, 5 ... (Trafford 2965)  
Lupton Street, Hunslet, Leeds, 10 ..... (Leeds 76514)  
Carl Street, Walsall, Staffs. .... (Walsall 6296)  
78 Duncruce Street, Belfast ..... (Belfast 45211)

# EVIDENCE!



Ordinary Portland Cement

Sulphate-Resisting  
Portland Cement

12 in. by 6 in. concrete cylinders mixed 4:2:1 with water/cement ratio of 0.6, made to Code of Practice. Both cylinders immersed for 30 Months in *Magnesium Sulphate* solution equivalent to 2%  $SO_3$ .

★ ★ ★



12 in. by 6 in. concrete cylinders mixed 4:2:1 with water/cement ratio of 0.6, made to Code of Practice. Both cylinders immersed for 30 Months in *Sodium Sulphate* solution equivalent to 2%  $SO_3$ .



Ordinary Portland Cement

Sulphate-Resisting Portland Cement

THE above reproductions of test specimens, made under identical conditions in our laboratory, illustrate the value of using S.R.P.C. Sulphate-Resisting Portland Cement for concrete work which is liable to the destructive action of soluble sulphates up to 2%  $SO_3$  by weight in soil or clay or 0.5%  $SO_3$  by weight in ground water.

## S · R · P · C

**SULPHATE-RESISTING PORTLAND CEMENT**



Full details will be sent on application to

**THE CEMENT MARKETING CO LTD**

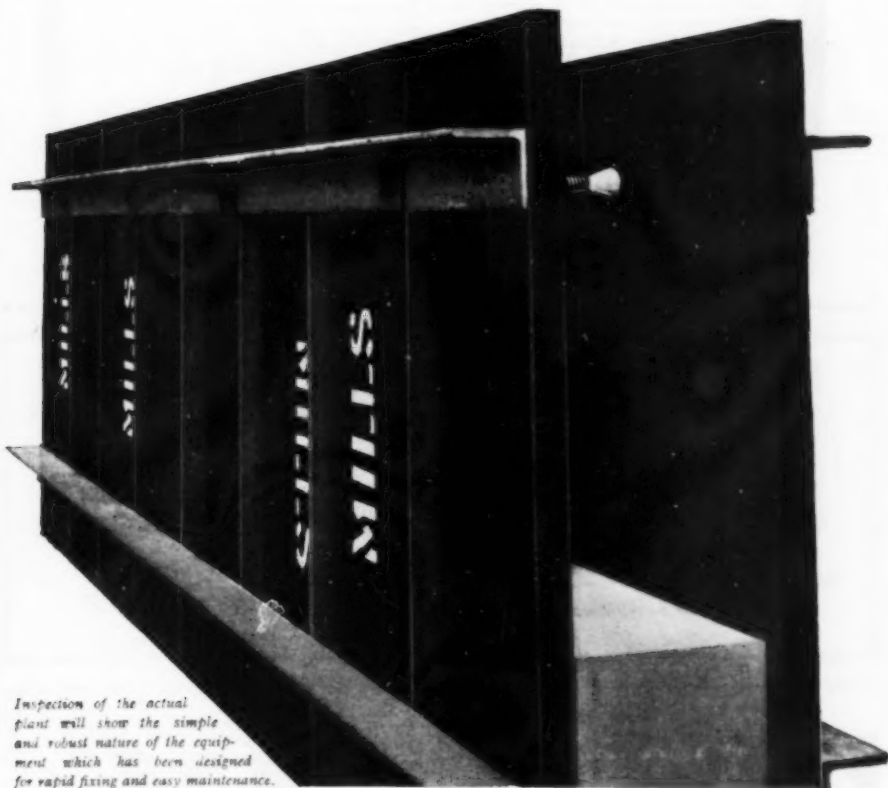
PORTLAND HOUSE · TOTHILL STREET · LONDON S.W.1

or G. & T. EARLE LTD · WILMINGTON · HULL

THE SOUTH WALES PORTLAND CEMENT & LIME CO LTD · PENARTH · GLAM

# MILFORMS

**FOR AUTOMATIC ALIGNING AND  
SELF-SUPPORTING SHUTTERING TO  
WALLS, FLOORS, COLUMNS AND BEAMS, ETC.**



*Inspection of the actual plant will show the simple and robust nature of the equipment which has been designed for rapid fixing and easy maintenance.*

This new range of formwork, for use on all types and systems of concrete construction, provides the Contractor with the means of overcoming formwork difficulties in an easy and economical way. No special tools are required, it is easy to erect and dismantle, and robustly constructed to withstand heavy wear. Full information can be obtained from any Mills Depot.

**MILLS**  
**SCAFFOLD CO., LTD.**

BELFAST • BIRMINGHAM • BOURNEMOUTH • BRIGHTON  
BRISTOL • CANTERBURY • CARDIFF • COVENTRY • CROYDON • DUBLIN  
GLASGOW • HULL • ILFORD • LIVERPOOL • LOWESTOFT • MAN-  
CHESTER • NEWCASTLE • NORWICH • PLYMOUTH • PORTS-  
MOUTH • SHIPLEY • SOUTHAMPTON • SWANSEA • YARMOUTH

Head Office & Depot: TRUSSLEY WORKS, HAMMERSMITH GROVE, LONDON, W.6. Tel: RIVerside 5026/9

## Ruberoid Expansion Jointings

RUBEROID CONTRACTION AND EXPANSION JOINTING was the original pre-cast jointing in this country. It moves with the pressure of expansion. It is resilient and resistant to deterioration. Supplied in lengths up to 6 ft.—to all depths of concrete—and in thicknesses varying from  $\frac{3}{8}$ " to 1". Further details and prices on application.

### Jointing of the cellular type

RUBEROID Crecel Jointing—which is also resilient and resistant to deterioration—is for use where a jointing of the cellular type, with a poured sealing compound, is required. It is supplied  $\frac{1}{2}$  inch less in depth than the depth of the concrete and the top channel is filled with Crecel Sealing Compound. Crecel Jointing is supplied in precast standard lengths of 4 ft. and in  $\frac{1}{2}$ -inch thickness.

Crecel Sealing Compound is supplied in  $\frac{1}{2}$ , 1 and 4 cwt. containers.

Approximate capacity in cavity  $\frac{1}{2}$  inch by  $\frac{1}{2}$  inch, 130 linear yards per cwt. When the Crecel Jointing is in position, and before the Sealing Compound is poured, the faces of the concrete in the cavity should be coated with Crecel Jointing Primer to ensure the most satisfactory and lasting results.

Crecel Jointing Primer is supplied in 5 or 10 gallon drums and has a covering capacity of 150 to 200 square feet per gallon.

*Use Ruberoid, the original Concreting Paper, in the road bed. It prevents absorption of liquid cement into the sub-base and aids free movement of the slab.*

A Product of: THE RUBEROID COMPANY LIMITED, 187 COMMONWEALTH HOUSE, 1-19 NEW OXFORD STREET, LONDON, W.C.1



## WASHED BALLAST, SAND, SHINGLE & Crushed Aggregate for Reinforced Concrete.

**WILLIAM BOYER & SONS, LTD.**

*Sand and Ballast Specialists,*

**IRONGATE WHARF,  
PADDINGTON BASIN, W.**

**MEMBERS OF B.S. & A.T.A.**

**DELIVERED DIRECT TO ANY  
CONTRACT BY MOTOR LORRY.**  
Quotations on Application.

Telephone: Paddington 2024 (3 lines).

# AQUAREP

SEND FOR  
DETAILS

for **100%**  
**WATERPROOF  
CONCRETE**

**DAMP-PROOFING LTD.**

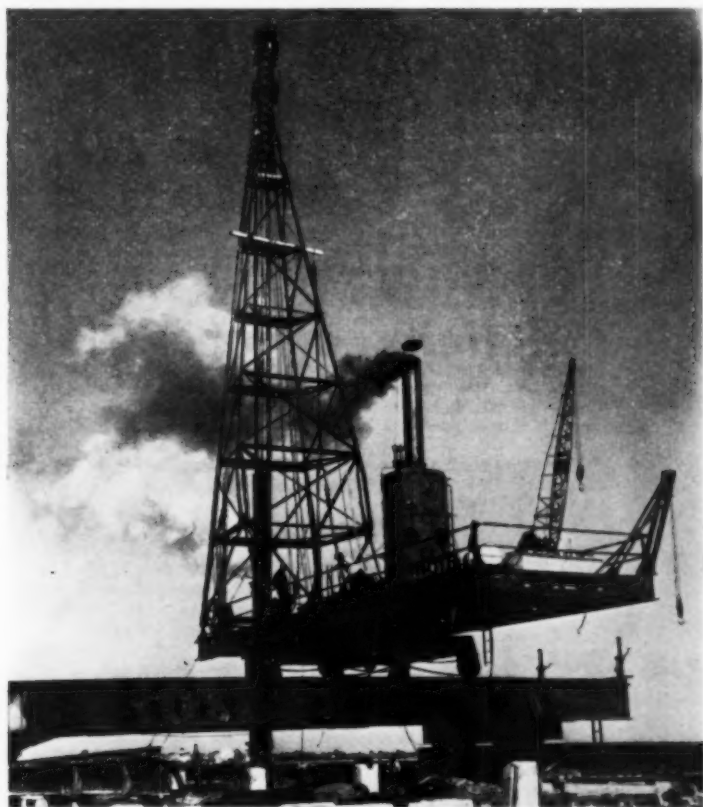
DEPTFORD Tel. TIDeway 1485-7 LONDON, S.E.





# **CHRISTIANI & NIELSEN LTD**

## **REINFORCED CONCRETE**



Pile Driving for Reinforced Concrete Jetty

**54 VICTORIA STREET,**

**LONDON, S.W.1.**

TELEPHONE: VICTORIA 6152

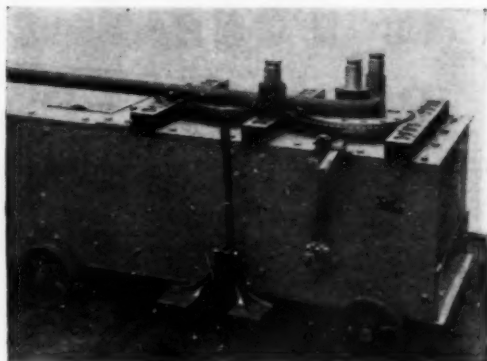
# POWER BAR BENDERS

## FOR ALL SIZES OF REINFORCING BARS

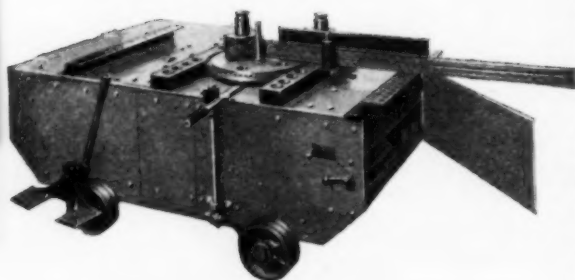
### STANDARD PRODUCTION MODELS

The ARD. 50 MODEL—as illustrated on right—has a capacity for cold bending Mild Steel Bars up to 2" dia. and incorporates a second Bending Head to give high-rate bending for small diameter bars.

The RAS. 40 MODEL shown below is a single disc machine of exceptional performance. With a capacity for  $1\frac{1}{2}$ " dia. bars, it bends at highest practical rate—e.g. a full hook takes only 3 seconds bending time.



*Ensure accuracy, economy  
& simplicity of operation*



### INTERESTING FEATURES

Either of the Models illustrated can be supplied motorised or engine driven.

Standard Accessories supplied include all necessary Formers and Bending Pins, a special Backrest for simultaneous bending of a number of small diameter bars, and Accessories for forming right-angle loops in one operation.

Special Safety Device incorporated to prevent damage to mechanism if overloaded.

The desired Bending Angle may be set mathematically, and this is of great assistance in Repetition Bending.

# CEMENT & STEEL LTD.

SECOND AVENUE

CHATHAM

KENT

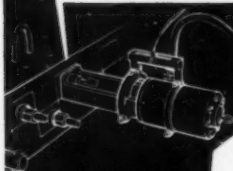
Telephone: Chatham 45580

Telegrams and Cables: Cembelgi, Chatham

1

**Prestressed Concrete (Lee-McCall System) with Macalloy Bars**

An economical and effective system of prestressing concrete, using high-tensile alloy steel in bar form. The steel is provided with positive end-anchorage and does not rely upon bond to transmit the stresses to the concrete.



**YOU CAN**  
*constructional*  
**SAVE STEEL**

*by using . . .*

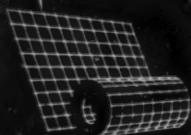
**REINFORCEMENT by McCALLS**

**"CHEAPEST IN THE  
LONG RUN"**

2

**'Matobar' Welded Fabric Reinforcement**

Economical for all types of concrete construction. Hard drawn, high-tensile steel wire mesh, electrically welded at every intersection; permissible working stress, 27,000 lb. per sq. in. in tension.



3

**Isteg Steel Reinforcement**  
manufactured under licence

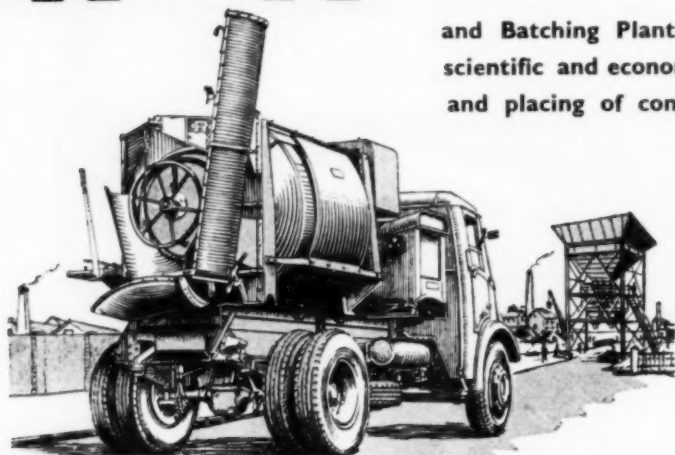
Steel bars with a combination of twist and cold working, giving 50% improvement in tensile stress; 30% less weight of steel. Improved bond; hooks and overlenghts eliminated.

Write for further details to:

**McCALL & CO (SHEFFIELD) LTD.**  
TEMPLEBOROUGH, SHEFFIELD, AND AT LONDON

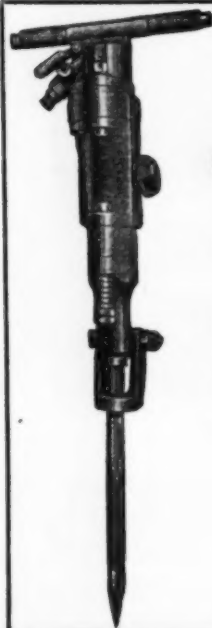
# **RAPIER** TRUCK MIXERS

and Batching Plants for  
scientific and economical mixing  
and placing of concrete.



Also makers of a full range of tilting, non-tilting and pan mixers and self-priming water pumps.

**RANSOMES & RAPIER LIMITED**  
IPSWICH—WATERSIDE WORKS. 32, VICTORIA ST., LONDON.



## THE "JOHN BULL" CONCRETE BREAKER

NEW "B.A.L." TYPE.

**INCREASED :—**

PENETRATION, RELIABILITY, LIFE.

**REDUCED :—**

VIBRATION, NOISE AND WEAR.

THESE ARE THE SALIENT FEATURES  
OF THE NEW CONCRETE BREAKER

★ ★ ★

**REAVELL & CO., LTD.**

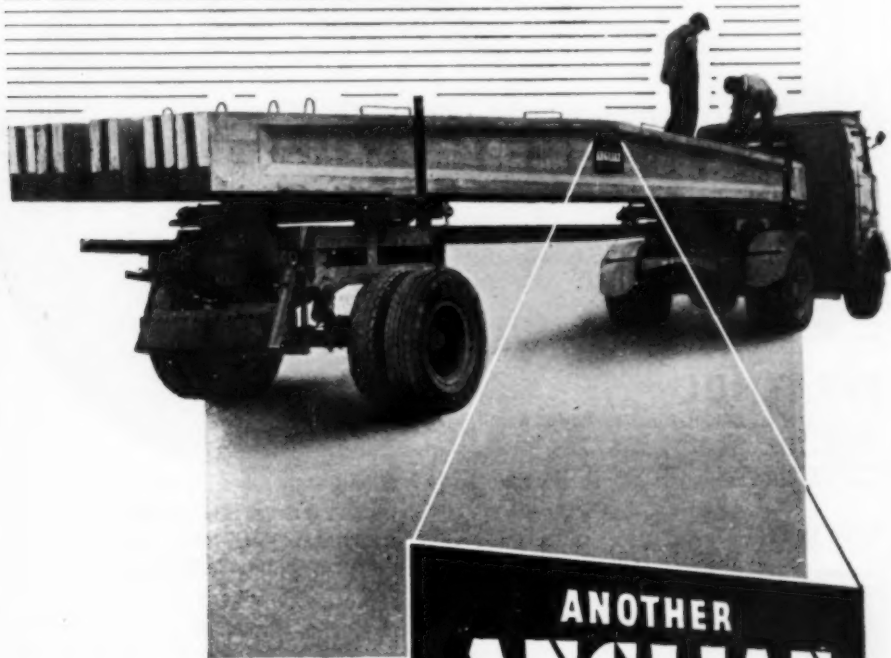
RANELAGH WORKS, IPSWICH.

TELEGRAMS: "REAVELL, IPSWICH."

TELEPHONE: 2124

# **PRESTRESSED ROOF BEAMS**

for the **MINISTRY of WORKS**



**PYLONS · PILES AND  
SHEET PILES · ROAD  
AND RAIL BRIDGES  
ROOF & FLOOR BEAMS**

**ANOTHER  
ANGLIAN  
PRESTRESSED PRODUCT**

**ANGLIAN BUILDING PRODUCTS LTD · LENWADE 15 · NORWICH · Tel. : Gt. Witchingham 91**

# MOULD OILS & COMPOUNDS

for every process of  
concrete production

## CONCREAM

This non-staining, smooth and easy working white mould oil can be used with confidence on all classes of in situ and precast concrete work where the use of a white mould oil is recommended.

## VIBRAMOL

This non-staining and non-separating mould oil is made specially for use on steel shuttering and moulds where vibrators are used, and provides a good film which is not readily moved under vibration.

## SPRAYMOL

This grade of mould oil has been specially produced for use with a spray gun. It can be used with great economy on all types of shuttering and moulds, and will not separate under pressure.

## "P.S."

Experience has shown that the production of precast and in situ prestressed concrete needs a special mould compound, and in collaboration with leading prestressed specialists we have produced Grade "P.S." Mould Compound for this class of work.

## "8.A."

This Mould Compound has been specially produced to satisfy the requirements of those engaged in the production of spun concrete products.

**CONCREAM** Regd.  
**VIBRAMOL** Regd.  
**SPRAYMOL** Regd.  
**"P.S." & "8.A."**

**PRODUCTS OF THE  
ORIGINAL MAKERS OF  
CONCRETE MOULD OILS**

We specialise in the production of mould oils and compounds for concrete work of every kind, from mass concrete work to high-class architectural stone work, and have an unrivalled experience which enables us to give expert advice on all mould oil problems. We have a grade for every purpose, and will be pleased to submit full details, samples, and prices on request.

**RICH<sup>d</sup> HUMBLE & SON, LTD., COLUMBA OIL WORKS, LEEDS, 3**

Telephone : 27155.

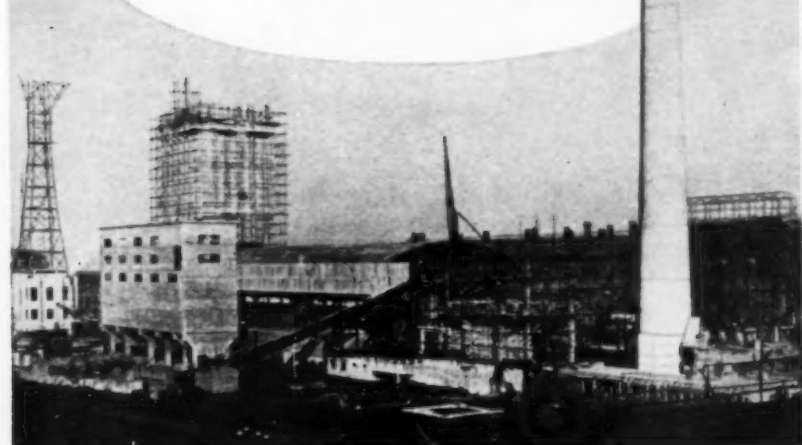
ESTABLISHED 1854.

Telegrams : "Columba, Leeds. 3."



**Concrete piles completely  
resistant to Mineral  
Sulphates and Gas-Lime**

*Made possible by using Aluminous Cement*



*Photograph by courtesy of South Eastern Gas Board.*

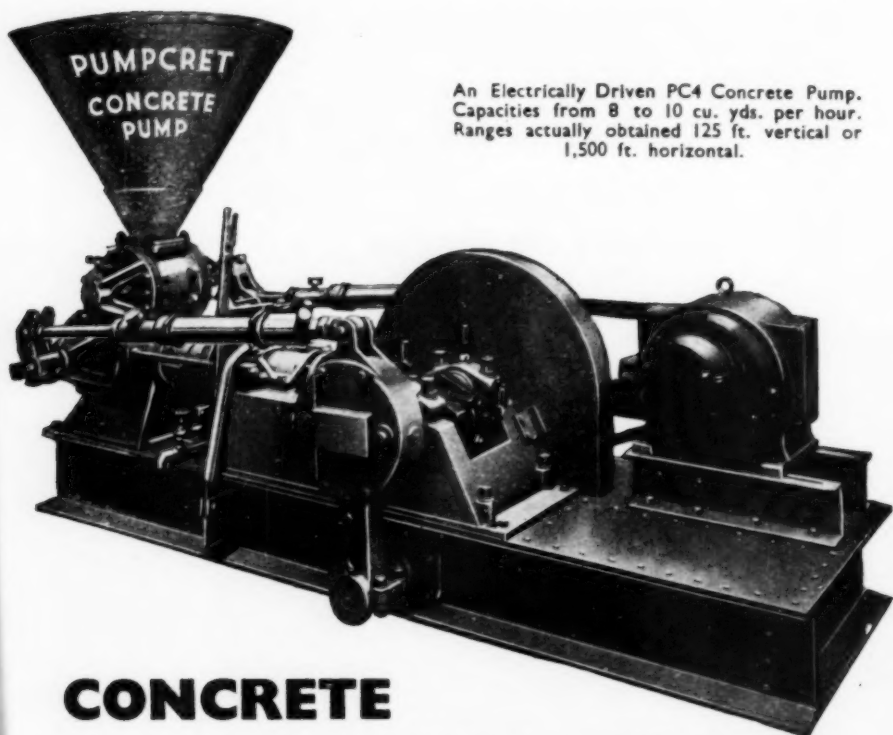
The photograph shows the new extensions to an important London Gas Works where piles made with Ciment Fondu have been specified and used because of its complete immunity to attack by mineral sulphates and gas lime.

*Write today for further particulars and latest literature*

**Concrete Rock-hard in one day**



**LAFARGE ALUMINOUS CEMENT CO. LTD**  
**73 BROOK STREET, LONDON, W.1. Telephone: MAYFAIR 8546**



An Electrically Driven PC4 Concrete Pump.  
Capacities from 8 to 10 cu. yds. per hour.  
Ranges actually obtained 125 ft. vertical or  
1,500 ft. horizontal.

## CONCRETE BY PUMP AND PIPELINE

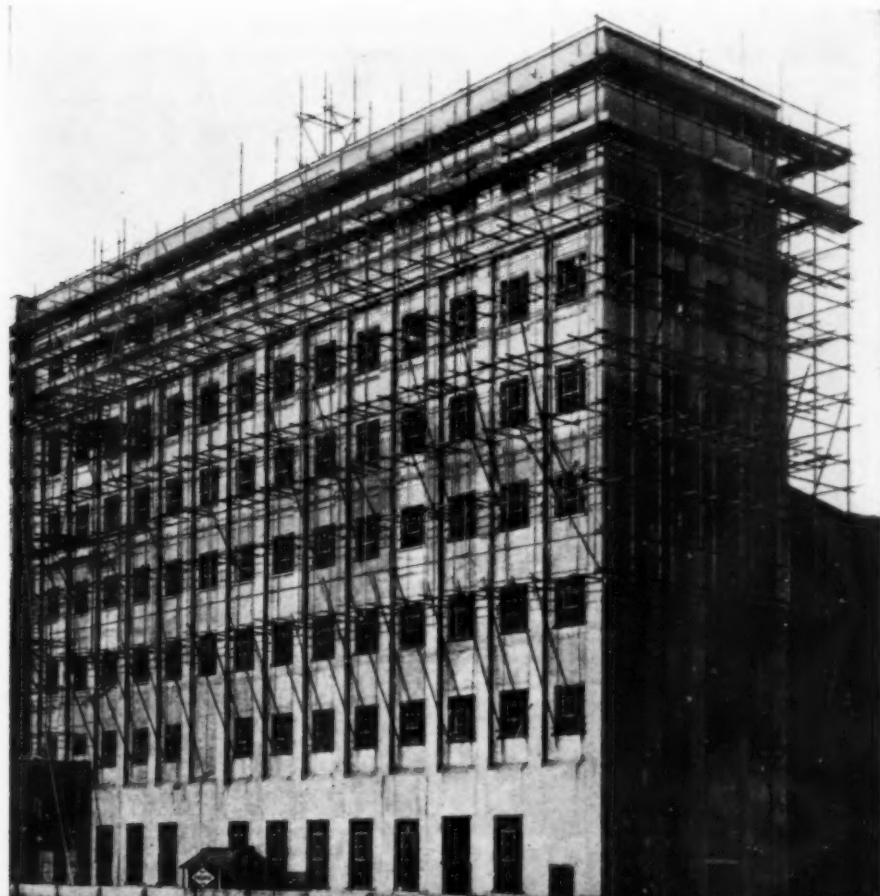
- The latest and most efficient method of placing concrete.
- Pump and Mixing plant can be located where it is most convenient for storing and handling aggregates and cement.
- The concrete is delivered by pipeline just wherever it is required with the minimum of interference with the building operations.
- The speed of the pump governs the whole of the concreting gang.
- Pumpable concrete must of necessity be good concrete.

### THE CONCRETE PUMP COMPANY LTD

4 STAFFORD TERRACE, LONDON, W.8

Telephone: Western 3546.

Telegrams: Pumpcret, Kens, London.



Construction of New Mill at Sun  
Flour Mills, Bromley-by-Bow for  
Messrs. J. W. French & Co

Consulting Engineers: Messrs.  
Andrews, Kent & Stone of 329,  
High Holborn, London, W.C.1.

W. & C. FRENCH LTD. HEAD OFFICE BUCKHURST HILL, ESSEX. TELEPHONE BUCKHURST 444

# GLASCRETE

**Reinforced Concrete  
and Glass**

This view of the interior of the Avon Pumping Station at Ringwood illustrates the excellent lighting value obtained by the use of GLASCRETE Double Glazed Construction.



**J.A. KING & Co. Ltd**

181 Queen Victoria St, LONDON, E.C4

Telephone: CENTRAL 5866 (6 lines)

Design and Construction by the late P. G. G. Moon, M.I.C.E., F.C.S., and the Engineering Staff of the Bournemouth Gas and Water Co.



**PIN YOUR FAITH  
TO THE TESTED  
BRAND.**

THIS LABEL ON  
EVERY BARREL  
CARRIES WITH IT  
FORTY YEARS'  
EXPERIENCE OF  
MANUFACTURE.

**NONE OTHER IS  
"JUST AS GOOD"**

**THE LEEDS OIL & GREASE CO.**

'Phone: 22480.

**LEEDS, 10**

'Grams: "Grease."

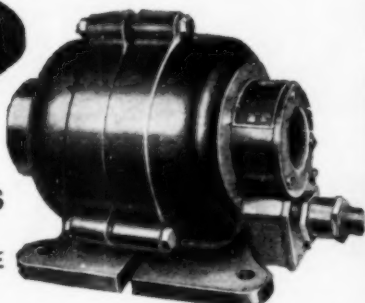
**PRESTRESSED CONCRETE**

BY THE  
LIVERPOOL ARTIFICIAL STONE CO. LTD.

USING



**TRILLOR  
ELECTRIC  
VIBRATORS  
AND  
QUICK RELEASE  
FITMENTS**

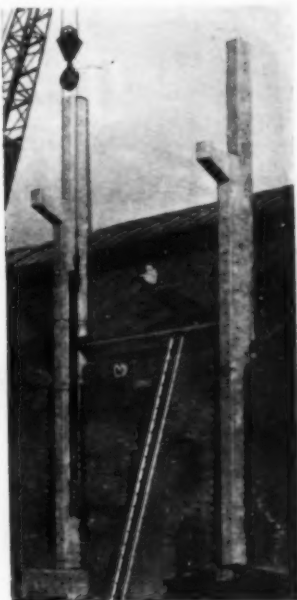


Details of these and other items of  
Vibrating Equipment sent on request.

**E. P. ALLAM & CO., LTD.**

LONDON: 45 Great Peter Street, S.W.1. Telephone: Abbey 6353 (5 lines)

SCOTLAND: 59 Cavendish Street, Glasgow, C.S. Tel.: South 0186. Works: Southend-on-Sea. Tel.: Eastwood 55245



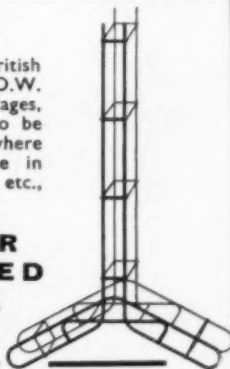
## CONCRETE REINFORCEMENT

### BENT TO SPECIFICATION

In 9 months we manufactured and supplied to the British Cast Concrete Federation, reinforcement for the M.O.W. Standard Hut involving 60,000 cut, bent and welded cages, and 5,000,000 stirrups, and therefore rightly claim to be specialists in the production of all types of cages where reinforced concrete is required. Whether for use in Garages, Runways, Docks, Warehouses, Forecourts, etc., "bending is carried out to your own Specification."

**CAGES FOR  
PRECAST  
CONCRETE**

**CAGES FOR  
REINFORCED  
CONCRETE  
FRAMEWORK**



**SOMMERFELDS LTD.**

WELLINGTON, SHROPS. Telephone: 1000 (5 lines)

& 167 VICTORIA ST., S.W.1 Telephone: VIC 1000



# FORD ENGINES

for

## INDUSTRIAL EQUIPMENT

Ford Industrial engines are widely used in providing power for Industrial Machinery of every description and have a power range between 10 and 60 B.H.P. when required for continuous working purposes. They are inexpensive to buy and economical to run. They give you long and trouble-free service, and what little maintenance they need is promptly and speedily carried out by Ford Service, which covers every part of the country. This combination of a first-class product and first-class service is the reason why Ford engines hold an unchallengeable reputation in every branch of industry. The advice of our Industrial Unit Department is freely at your disposal.

Why not discuss your power problems with us?



**FORD MOTOR COMPANY LIMITED • DAGENHAM • ESSEX**



# REINFORCED CONCRETE CONSTRUCTION



These Photographs

(by courtesy of North Western Gas Board)

Illustrate :—

**REINFORCED CONCRETE  
RETAINING WALLS.**

RECENTLY CONSTRUCTED BY US  
NEAR MANCHESTER.

WE ARE ALWAYS PLEASED TO  
QUOTE FOR :—

**HEAVY  
EXCAVATION.  
FOUNDATIONS.  
REINFORCED  
CONCRETE.**



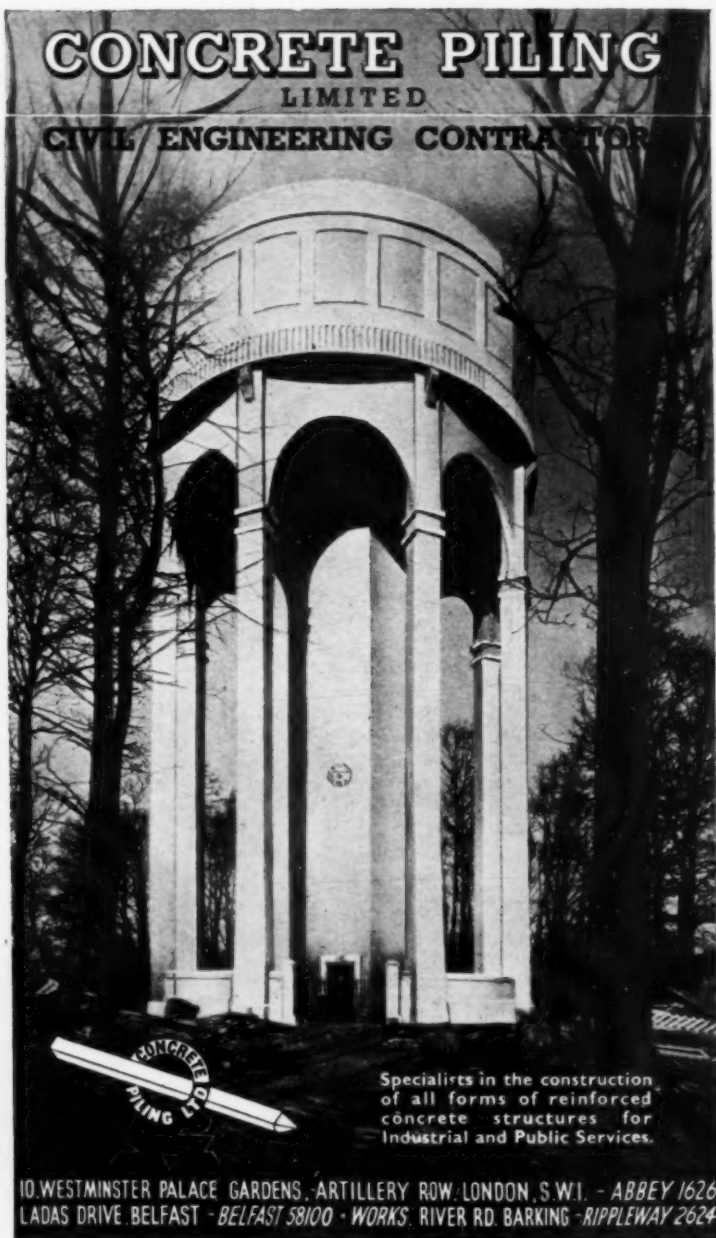
**UNITED KINGDOM CONSTRUCTION**

CIVIL ENGINEERING CONTRACTORS

# CONCRETE PILING

LIMITED

CIVIL ENGINEERING CONTRACTORS



Specialists in the construction  
of all forms of reinforced  
concrete structures for  
Industrial and Public Services.

10, WESTMINSTER PALACE GARDENS, ARTILLERY ROW, LONDON, S.W.1. - ABBEY 1626  
LADAS DRIVE, BELFAST - BELFAST 58100 - WORKS, RIVER RD. BARKING - RIPPLEWAY 2624



**Reinforcement**  
*by*  
**T.C. Jones & Co. Ltd**  
REINFORCEMENT ENGINEERS • STRUCTURAL ENGINEERS  
WOOD LANE, LONDON, W.12 Phone SHE 3001  
600  
ROUTE STREET, CARDIFF • THEOBALD CLAR

# GUNITE AND CEMENTATION



Systematic repairs to structures  
based on systematic diagnosis of  
defects.

## WHITLEY MORAN & CO. LTD.

*Specialists in the Repair of Engineering Structures*

**GUNITE**

5 OLD HALL STREET, LIVERPOOL.

Telephone: Central 7975

make the most  
of your steel  
allocation with

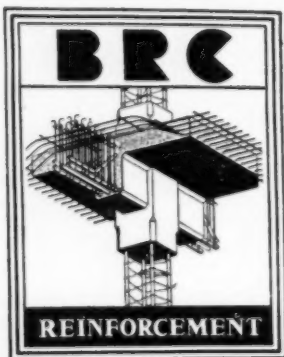
# SECROM

## BUTT-WELDING

● No preliminary preparation of bars ● Perfect alignment assured ● Great saving in time over other processes ● No special skill needed ● No more short ends wasted.

### THE SECROM WELD IS AS GOOD AS THE BAR

Send for full details. M. SEMET & CO., LTD., 2 CAXTON STREET, LONDON, S.W.1.



### "CONCRETE SERIES" BOOKS ON CONCRETE

For a complete catalogue giving prices in  
sterling and dollars, send a postcard to:

CONCRETE PUBLICATIONS, Ltd.  
14 Dartmouth St., London, S.W.1  
England



Part of a large and extensive factory at Brynmawr, South Wales.

Architects : Architects' Co-operative Partnership.

Consulting Engineers : Ove Arup & Partners.

# SHELL REINFORCED CONCRETE

in domed roofs  
and barrel vaults  
constructed by

**GEE**  
WALKER & SLATER LTD

Some of the outstanding features of this contract are the construction of nine concrete shell domical roofs, each 80 ft. by 60 ft., covering the main production area, and forty-four shell concrete barrel vault roofs.

100 PARK LANE, LONDON, W.1.

UTTOXETER OLD ROAD, DERBY, and COYCHURCH RD., BRIDGEND, GLAM.

# ★ CHASTON

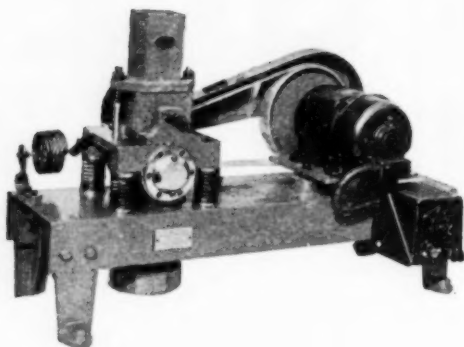
**SPECIALIST CONTRACTORS  
FOR REINFORCED CONCRETE  
AND PRECAST PRODUCTS**

WE INVITE YOUR  
ENQUIRIES FOR CON-  
CRETE WORK OF ALL  
KINDS, IN STANDARD  
OR SPECIAL DESIGNS

## PRESTRESSED STRUCTURAL UNITS

DAVID CHASTON LTD., ESSEX ROAD, HODDESDON, HERTS.  
Telephone: Hoddesdon 2264 (3 lines).

## "CAPCO" H. F. VIBRATOR



for compacting mortar cubes  
for Compression Test B.S.  
12/1947, B.S. 915/1947,  
B.S. 146/1947, B.S. 1370/  
1947. New type automa-  
tic control—optional. The  
vibrator illustrated in the  
B.S. was built in our works.

The "CAPCO" range of con-  
crete testing apparatus also  
includes Cube Moulds; Slump  
Cones; Tensile, Vicat, and Cylin-  
drical Moulds; Tile Abrasion  
Machines; Compacting Factor  
Apparatus.

Full details on request.

### CAPCO (SALES), LTD.

BEACONSFIELD ROAD, LONDON, N.W.10. Telephone: WILLEDEN 0067-8. Cables: CAPLINKO, LONDON

(Sole Agents for all  
"Capco" Products)





A new type immersion vibrator  
Petrol or Electric

★ *FASTER PLACING -  
BETTER CONCRETE -  
LOWER MAINTENANCE COSTS*

THE HIGH-FREQUENCY VIBRATOR  
WITH THE SLOW-SPEED DRIVE



10,000/12,000

Vibrations per minute

● Send for descriptive leaflet ●



VIBRATOR Dept., PORDEN RD., BRIXTON, LONDON, S.W.2

Tel. : Brixton 3293 (9 lines)

and at Brentford



*We are Specialists in the Repair and  
Reconditioning of Defective Reinforced  
Concrete Structures, etc.:*

THE  
**GUNITE**  
CONSTRUCTION CO. LTD.

WESTERN HOUSE, HITCHIN, HERTS.

Tel. HITCHIN 571.



A symbol of quality materials, experienced workmanship, expert supervision, and excellent service.

*for all forms of*  
**PRECAST  
 CONCRETE**

We specialise in the production of Precast Concrete structural members to standard or special designs, also products for the Electrical Industry, Sports Ground Contractors, and Fencing Contractors, and shall be pleased to submit quotations for your requirements.

## **H.B. CONCRETE CO. LTD.**

Head Office and Works : VICARAGE ROAD, EGHAM, SURREY. Telephone : Egham 3092.

# **GUNITE SPECIALISTS**

## **WM. MULCASTER & CO. (CONTRACTORS) LTD.**

We invite inquiries for Gunite Linings and Renderings for new or old structures of every kind in any part of the country.

**HASLINGTON**

**CREWE**

Telephone : Crewe 2265-6.

# Cut costs; be more competitive:

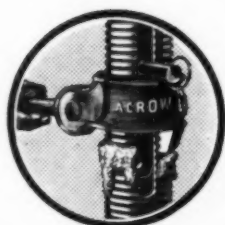
use:—

# ACROW

## the world's largest selling

# PROP

WELL OVER 1,000,000 IN USE

—proof positive of their  
paramount superiority

★ Only Acrow Props  
have the Acrow (patent)  
Self-Cleaning Device

—a downward extension of  
the nut over a segment of its  
circumference which forces  
away dirt lodged in the threads  
with an easy shearing action as  
the nut is turned. It enables  
props to be made ready for  
work instantly, no matter how  
encrusted the threads may be.

\*Striking\* on the site is easier, too, and involves none of the strain  
which might otherwise cause damage.

PROP SIZE No.	HEIGHT		WEIGHT
	Closed	Extended	
1	5 ft. 7 in.	9 ft. 10 in.	48 lb.
2	6 ft. 7 in.	10 ft. 10 in.	50 lb.
3	8 ft. 2½ in.	12 ft. 5½ in.	58 lb.
4	10 ft. 6 in.	15 ft. 6 in.	70 lb.

FOR SALE OR HIRE

## ACROW—THE Specialists in Steel Shuttering & Propping

All enquires to: **ACROW (ENGINEERS) LTD.**, South Wharf, London, W.2: Ambassador 3456 (20 lines)  
 22-24 City Road, Bristol, 2 (Bristol 24595) ● 130 Coventry Drive, Glasgow, E.1 (Bridgeton 1041)  
 Lupton Street, Hunslet, Leeds, 10 (Leeds 76514) ● West Stanley Street, Manchester, 5 (Trafford 2965)  
 Carl Street, Walsall, Staffs. (Walsall 6296) ● 78 Duncrue Street, Belfast (Belfast 45211)

# STENT PILES

USED FOR THE NEW 150 ft. FACTORY  
EXTENSION FOR FORD MOTOR  
COMPANY LTD., DAGENHAM.

- ★ THEY'RE SAFE
- ★ THEY'RE ECONOMICAL
- ★ LARGE RANGE OF STOCK SIZES

Technical details  
supplied on request to:-

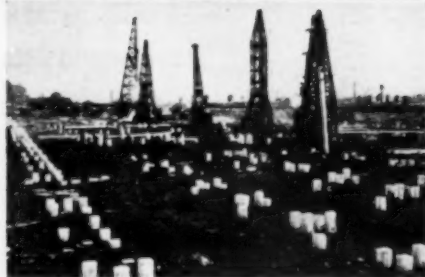
# STENT

PRECAST  
CONCRETE  
LTD.

Sales: 1 Victoria Street, S.W.1. Phone: Whitehall 2573

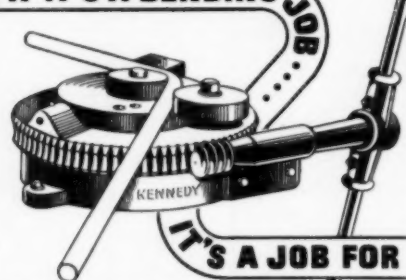
Works: Dagenham Dock, Essex. Phone: Rainham (Essex) 780

Midland Agent: Fabian J. M. Jackson, M.In.B.E., M.I.P.E., 11 Leicester Road, Loughborough. Phone: Loughborough 3781 and 3543. 56 St. Mary's Road, Manchester, 10. Phone: FAI 2623.



Photographs by kind permission of Ford Motor Company Ltd.

IF IT'S A BENDING



# KENNEDY

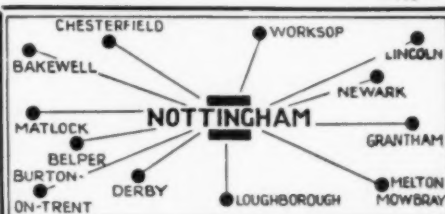
REGD. TRADE MARK

# BENDING MACHINES

... featured above is Model 2A BAR-bending machine for the accurate and rapid cold bending to precise measurement of mild steel reinforcing bars of up to 1½" diam.

For full particulars of this and other Kennedy benders, write to :-

W. KENNEDY LTD., Dept. C, STATION WORKS,  
WEST DRAYTON, MIDDX. Phone: West Drayton 2084



# Trent Gravels

10,000 tons per week

Washed & Crushed 1½ in. to ¾ in.

We are the leading suppliers of high-class concrete aggregates in the area shown above. Prompt deliveries guaranteed and keen competitive prices quoted. Send for samples and prices.

# TRENT GRAVELS LTD

ATTENBOROUGH

NOTTS

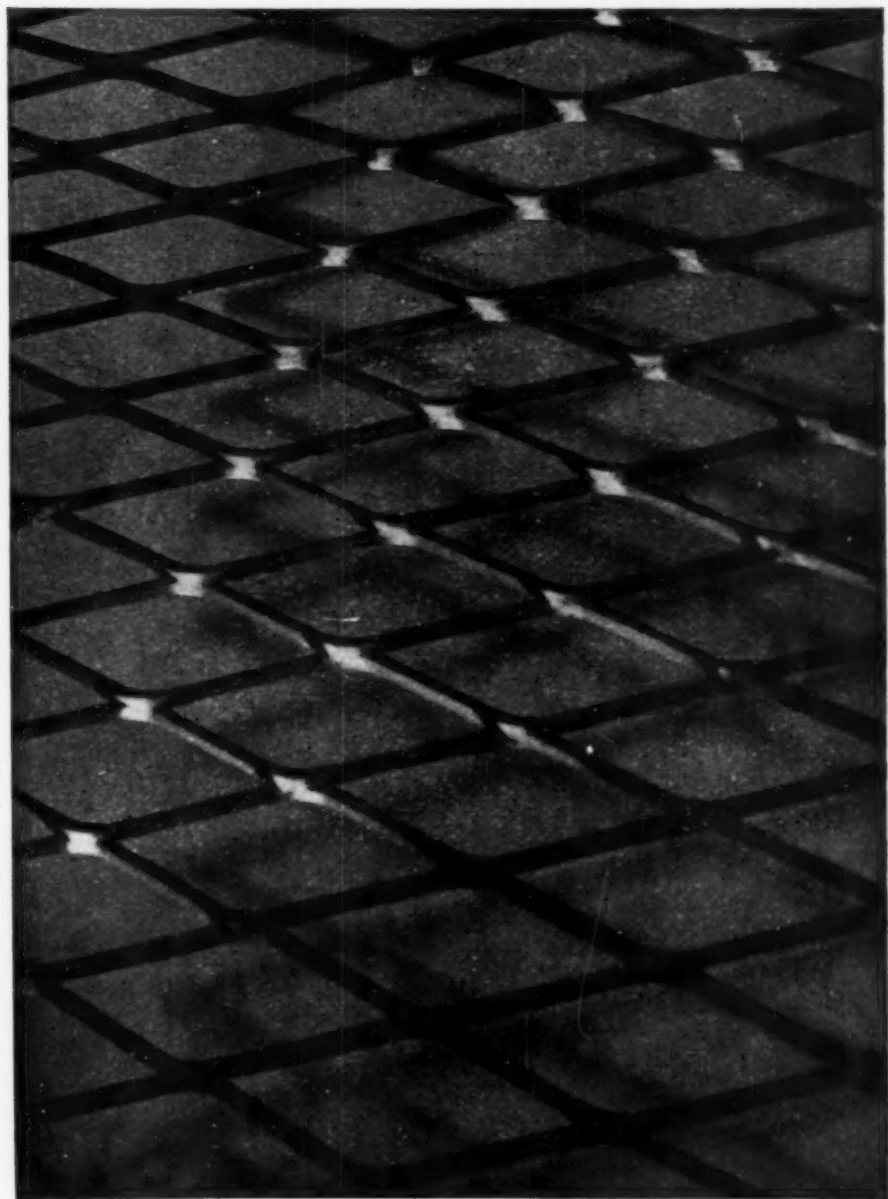
Telephone: Beeston 54255.

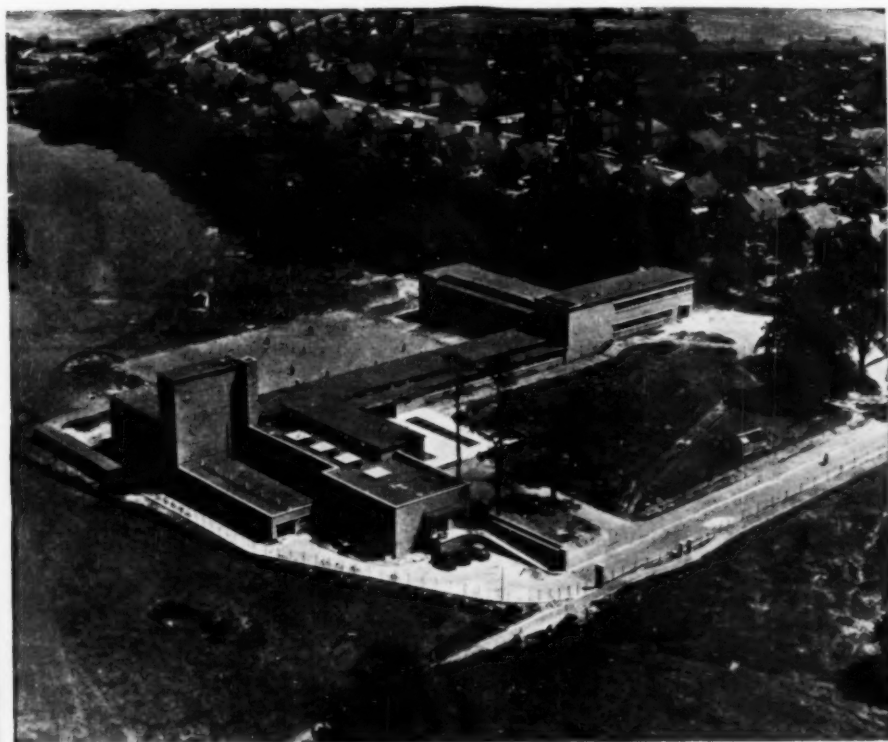
# "CONCRETE SERIES" BOOKS ON CONCRETE

For a complete catalogue giving prices in sterling and dollars, send a postcard to:

CONCRETE PUBLICATIONS, Ltd.  
14 Dartmouth St., London, S.W.1

**‘Expamet’ Expanded Steel**—the reinforcement with unequalled mechanical bond • The Expanded Metal Company Limited, Burwood House, Caxton St., S.W.1. Whitehall 1736 : Stranton Works, West Hartlepool. Hartlepool 2194. Also at Aberdeen, Belfast, Birmingham, Cambridge, Cardiff, Exeter, Glasgow, Leeds, Manchester





CHISLEHURST & SIDCUP BLACKFEN  
COUNTY SECONDARY SCHOOL  
FOR BOYS, KENT COUNTY COUNCIL

E. B. Musman, B.A., F.R.I.B.A., Architect, in collaboration with S. H. Loweth, F.S.A., F.R.I.B.A., Kent County Architect.

**RUSH & TOMPKINS LTD.**

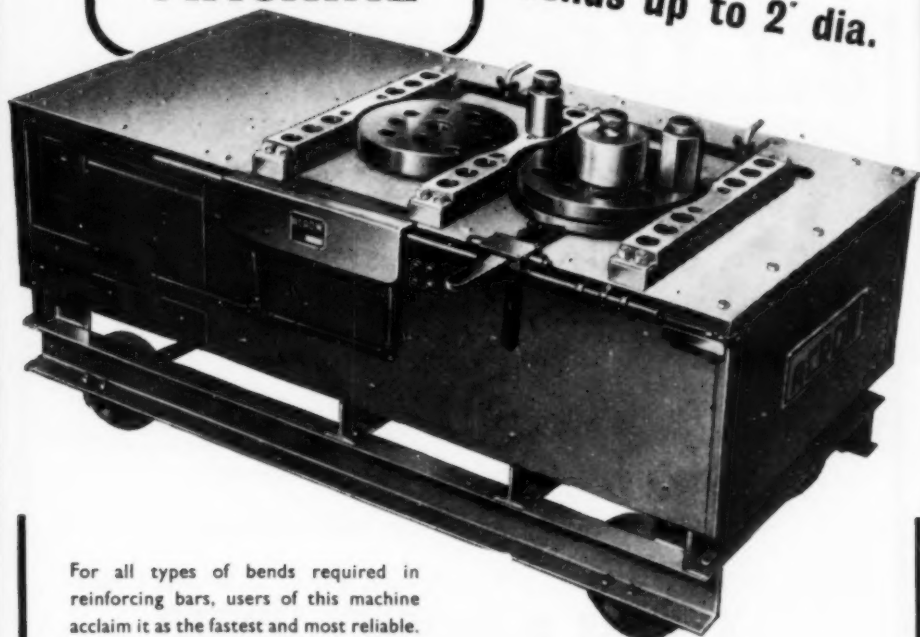
SIDCUP · LONDON · BIRMINGHAM · DURBAN, NATAL

formerly KENT & SUSSEX CONTRACTORS, LTD.



**ACROW**

*Electric*  
**BAR  
BENDING  
MACHINE**

*fastest**most accurate**minimum of handling**automatic repetition**bends up to 2" dia.*

For all types of bends required in reinforcing bars, users of this machine acclaim it as the fastest and most reliable. Bends single bars up to 2" dia. or a group of bars of combined cross-sectional area up to 3 sq. ins. Ideal for repetition work. Simple and foolproof in operation.

*For full details and price write to :—*

**ACROW (ENGINEERS) LTD.**

South Wharf, Paddington, London, W.2	Ambassador 3456
22-24 City Road, Bristol, 2	Bristol 24595
130 Coventry Drive, Glasgow, E.1	Bridgeton 1041
Lupton Street, Hunslet, Leeds, 10	Leeds 76514
West Stanley Street, Manchester, 5	Trafford 2965
Carl St., Walsall, Staffs.	Walsall 6296
78 Duncrue Street, Belfast	Belfast 45211

# MONK

OF

## WARRINGTON & LONDON

*are organised and equipped  
to carry out*

REINFORCED CONCRETE  
CIVIL ENGINEERING  
& BUILDING CONSTRUCTION

*This organisation has been  
responsible for the construction of many  
major projects at Home and Overseas*

### **A. MONK & COMPANY LIMITED**

*Head Office:*  
Padgate, Warrington  
Tel: Warrington 2381

*London Office:*  
75, Victoria Street, S.W.1  
Tel: Abbey 2651

ABBAY WORKS PORT TALBOT

1,750,000  
TONS

*founded on  
154 miles of*

# FRANKIPILES

At no other place on this planet has such a tremendous load as this been carried on any individual system of piling. FRANKIPILES have, therefore, established a World Record.

**FRANKIPILES CARRY MORE TONS PER PILE**

---

THE FRANKI COMPRESSED PILE COMPANY LIMITED

39, Victoria Street, London, S.W.1

'Phones : ABBey 6006-9. 'Grams : Frankipile, Sowest, London

and

AUSTRALIA • BRITISH WEST INDIES • NEW ZEALAND • SOUTH AFRICA

---

# PROMETO

(REGD. TRADE MARK)

**moving-forms**  
**for monolithic**  
**concrete construction**



**a rapid and**  
**highly economical**  
**method of erecting**  
**structures of all kinds**

PROMETO hydraulically controlled moving forms and equipment enable a high rate of construction to be maintained with minimum labour requirements. They provide the means of making substantial savings in the cost of erecting Silos, Chimneys, Water Towers, Multi-Storey Flats, the lining of Mine and similar shafts, Elevator Houses, and many other types of structures. We have the sole rights for the manufacture and use of PROMETO equipment in the United Kingdom and are prepared to enter into sub-licence arrangements with selected Contractors for individual jobs or prescribed districts. Enquiries are invited from Consulting Engineers and Architects.

**WILLIAM**

**THORNTON & SONS LTD**  
**WELLINGTON ROAD**  
**LIVERPOOL**

*Building and Civil Engineering Contractors*

# CONCRETE AND CONSTRUCTIONAL ENGINEERING

INCLUDING PRESTRESSED CONCRETE

Volume XLVII. No. 5.

LONDON, MAY, 1952.

## EDITORIAL NOTES

### Methods of Testing Concrete.

No method of testing materials can be entirely satisfactory when the strength throughout a large mass is assumed to be the same as the strength of small samples subjected to test. This is true in the case of a finished material, but in the present common method of assessing the strength of a mass of concrete in a structure by the strength of small samples taken as the material leaves the mixer we are assuming that samples of a semi-finished product will give a true representation of the properties of the finished product made under different conditions. This can seldom be so. The sample is packed into a small steel mould by a man whose object is to get as high a strength as possible. The remainder of the semi-finished product is shovelled or tipped into shuttering which may be of steel or wood, and consolidated and cured by men who are much less concerned to produce concrete of the highest strength or to simulate on the site the processes used by the man who takes the samples—even if it were possible to do so. The strength of concrete in a structure can be, and generally is, very different from the strength of the test cubes. Also, however carefully materials and water are measured to ensure uniformity in every batch, the differences in the quality of the hardened concrete in various parts of a structure can be, and are, considerable. In a recent case concrete in an important part of a structure had to be removed at great expense because men who were dissatisfied with their working conditions deliberately skimmed their work, and most engineers know of cases where batches of inferior concrete have been produced as a result of ignorance or carelessness. Test cubes give an idea of the strength that is possible with the materials used, but are not a guarantee that all of the concrete in a structure will have the same strength as the test cubes. In ground slabs it is possible to drill cores from the finished work, and these give a more reliable indication of the strength of the concrete as laid. It is not possible, however, to take cores from all parts of a structure, and in these circumstances, until a better method is devised, the testing of "works cubes" is used as a guide to the strength of the finished concrete.

This problem has recently been considered by the Committee for Reinforced Concrete in Germany (the Deutscher Ausschuss für Stahlbeton), which has supervised tests of a method devised by Professor Baumann in which a ball operated by a spring is impinged upon the hardened concrete. In a report recently issued, entitled "Die Kugelschlagprüfung von Beton,"\* the committee recommends

\* Published by Wilhelm Ernst, Berlin. Price 7.50 D.M.

that this method be adopted in place of test cubes. As in the Brinell test, the hardness is measured by the size of a depression made by the blow of a ball on the surface, and this measurement is correlated to the strength of the concrete as shown by actual crushing tests. In the experiments more than seven hundred cubes were made, and these were tested at ages ranging from seven days to fifty-six days after the specimens were cast. The compressive strength of the concrete was plotted against the diameter of the depression made by the ball, and from the results a curve was interpolated representing average values computed from regression equations derived from the theory of probability. In the case of a depression of 5 mm. diameter, the average cube strength of the concrete was found to be 4960 lb. per square inch and the minimum 3820 lb. per square inch. With a depression of 4.5 mm. diameter the average strength was 7700 lb. per square inch and the lowest 6150 lb. per square inch. As would be expected, small variations in the diameter of the depression indicate great differences in the strength of the concrete, and the measurement of the indentation made by the ball must therefore be accurate. Special magnifying glasses permitting readings to one-tenth of a millimetre are recommended for this purpose. The investigations described in the report relate to dense concrete only. The apparatus is 14 in. long and weighs  $5\frac{1}{2}$  lb., and can give impacts of  $43\frac{1}{2}$  lb. or 10.8 lb. per square inch.

It is much in favour of this method of testing that it can be applied to the hardened concrete in a structure and aims at indicating the actual strength rather than, as in the case of tests on cubes and cylinders, giving an indication of what the strength might be under conditions that cannot be realised in actual work. However, it seems that the difference in strength as shown by this apparatus was about 50 per cent. between the highest and the lowest. This is a greater variation than is common in crushing tests, and may indicate that this impact test is even less reliable than crushing tests. Also, it appears that the tests were made on cubes all of the same size, and no information seems to be available on the effects of the impact on parts of a structure which are thicker or thinner than the cubes tested. This is a matter of major importance, for if the depth of the depression is an indication of the strength of the concrete near the surface only the test may lead to fallacious conclusions. The test can be quickly and cheaply made and applied to many parts of a structure, but unless it indicates the strength of the concrete throughout a structural member it serves no more useful purpose than does the use of a spring-controlled hammer to ascertain whether the concrete is hard enough to allow the removal of shuttering with safety.

For example, the depth of penetration of the ball may depend upon whether or not there is a piece of large aggregate immediately below the point of impact, in which case it might be that the penetration would be less than if there were a greater depth of mortar; the strength indicated would then depend upon the amount of spading of the concrete against the shuttering. Further, excessive spading or vibration would bring to the surface a rich and strong mortar, and the apparatus might indicate a high-strength concrete although the core might be weak because it has been deprived of cement. The strength of concrete depends primarily upon the strength of the mortar, but it is necessary to be sure that the mortar is of the same strength throughout the concrete. What is needed is a method of test similar to that used by a cook when she plunges a needle into a cake to see if it is properly cooked throughout.



## Cooling-water Intake Structure at an Oil Refinery.

By **B. H. BROADBENT**, B.Sc.(Eng.), A.M.Inst.C.E.

PRESENT conditions add to the numerous questions which have always to be studied in determining the type of construction to be used for a given purpose. The cooling-water intake structure for the Vacuum Oil Company's refinery on the river Thames at Coryton had to be designed for rapid construction at a time when it was almost impossible to obtain a promise of delivery of steel and before the present system of priorities had been introduced. It had originally been proposed



**Fig. 1.—Intake Arriving at Coryton.**

to construct the intake structure in a cofferdam of steel sheet piling, but due to the depth of water at the river site and the steeply-sloping clay and silt bank this would have been a difficult operation, requiring a considerable quantity of heavy-section piling which seemed unlikely to be available for at least twelve months. A similar difficulty was present in any scheme requiring the large quantity of fabricated steel necessary for a steel caisson. Reinforced concrete, with its relative economy in steel and the versatility with which material in stock can be utilized, offered more promise of a solution of the problem, especially as there could be some pooling of the steel required for this purpose with the large quantities of reinforcement bars already ordered for the construction of the

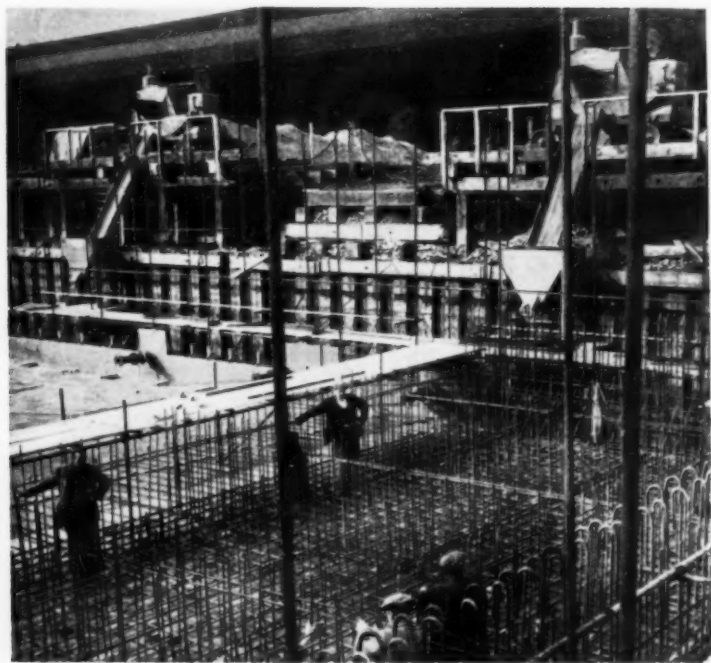


Fig. 2.—Construction at Gravesend to Height of 12 ft. 6 in.

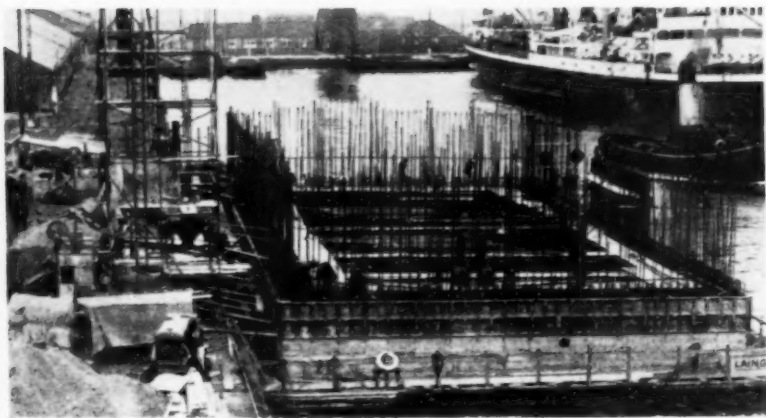


Fig. 3.—Construction at Tilbury to Height of 52 ft. 6 in.

refinery. By close co-ordination between design and construction, also, the sizes of the reinforcement bars could be altered to suit the sizes of bars available at any time. Since steel sheet piling was not available, some form of caisson which could be either lowered from staging over the final site or floated into position seemed likely to be the best solution.

The site of the intake is at an exposed part of the Thames estuary where tidal currents are strong, and construction had to be begun in the autumn and carried on through the winter. Moreover, the bed of the river at the site consists of a thin layer of silty clay overlying exceptionally compact ballast into which it is difficult to drive timber piles to a sufficient depth to ensure lateral stability. The cutting-edge of a caisson would have to be pitched at a depth of about 40 ft. below mean tide level before sinking began, and normal spring tides rise about

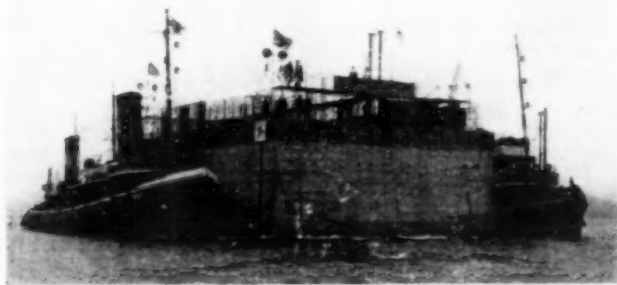


Fig. 4.—Under Tow from Tilbury to Coryton.

8 ft. above the mean. All this made construction on a piled staging undesirable. On the other hand, it was impossible to find a suitable nearby site for constructing the intake structure on land and floating it into position. The whole of the refinery area, as well as a large district behind it, lies below high-water level and is protected by a clay bund which has to be meticulously maintained.

A building site at a greater distance, where construction could proceed unhampered by storms and tides, was therefore sought. As only one structure had to be built it was also desirable to make use of existing facilities as far as possible. A dock was found, near Gravesend, which had been used during the war for building anti-aircraft gun-towers (which were floated into position and sunk in the Thames estuary) and concrete floating dry docks. Here a draught of about 10 ft. was available at high-water spring tides, and the only preparation necessary was to clear the silt which had accumulated since the dock was last used and to construct a temporary dam to keep out the water during building. This dam was constructed of two rows of steel sheet piling, tied together and filled with ballast. In the dock, the floor of the structure was cast on hollow slabs and the external walls, with the necessary internal bracing, were built up to a height of 12 ft. 6 in. (Fig. 2). On November 30, 1951, after removal of the temporary dam, the structure was floated at high tide and towed across the river into Tilbury Docks where the Port of London Authority had made a ship's berth

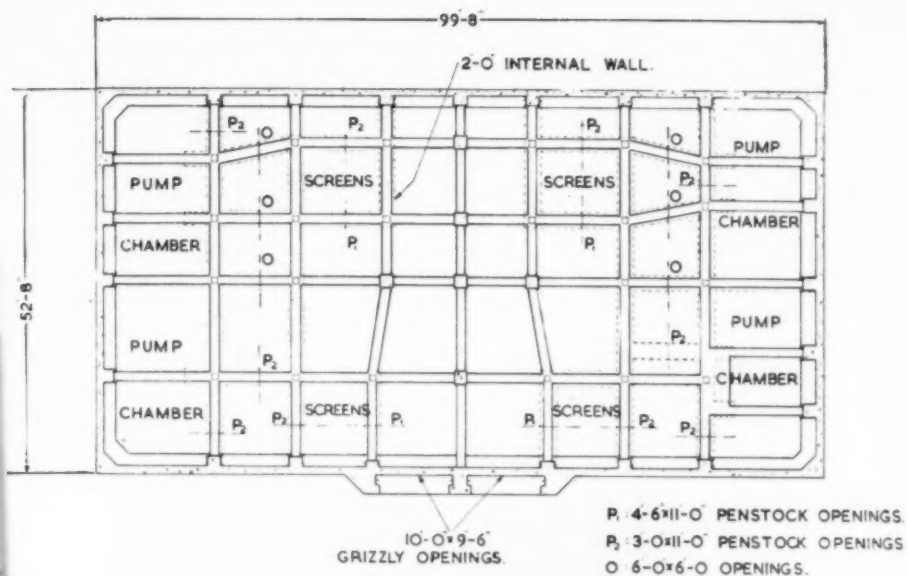


Fig. 5.—Plan.

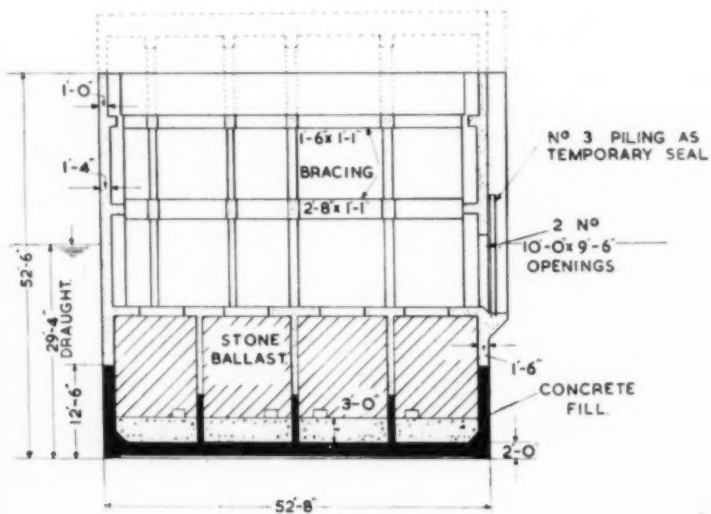


Fig. 6.—Transverse Section.

[Dotted lines indicate walls and deck to be built at Coryton. The ballast is shown hatched in Fig. 6.]

available. This berth provided an adequate depth of still water unaffected by tidal variations, and construction was continued afloat (*Fig. 3*) to a total height of 52 ft. 6 in.

Having reached this stage the structure was towed out of Tilbury Docks at high water on the morning of March 6, 1952, and taken down river with the falling tide by four large ships' tugs (*Fig. 4*). A bolster-barge had been moored alongside a group of timber piles to mark the position of the intake, and, with the aid of four wire cables attached to winches on the shore, the tugs brought the structure into position at low water (*Fig. 1*). It was then flooded, through twelve 6-in. valves built into the sides, and sunk on to a level bed which had been prepared by dredging. This rather delicate operation was successfully carried out, the final position being well within the tolerance allowed.

The bed of the river at Coryton has remained stable over a long period with little erosion or deposition, and near the surface there is a deep bed of very compact ballast. A solid foundation on this was preferred to a piled base and, although borings indicated that a suitable base would be found by dredging, provision was made for the possibility of excavating through the floor, if required, and pipes were also installed which could be used for injecting grout under pressure to fill any cavities due to irregularities of the bed.

The depth of water at high tide made it necessary to build a relatively lofty structure, and the high water pressures to be resisted required a fairly strong structure, so that it became difficult to secure adequate stability with a reasonable draught while the structure was afloat. It was decided that the draught must not exceed 30 ft. and the design provided for a draught of 29 ft. 4 in.

The design was complicated as provision had to be made for a wide variety of loadings to which the structure would be subjected at every stage of construction, afloat, and in its permanent position, the total weight had to be strictly limited until the structure was sunk in position, and construction had to be begun as soon as sufficient details for the first stages could be ready. Stability had to be maintained at all stages of construction afloat, and as soon as concrete was placed it became part of the structure and was consequently subjected to stress before the concrete had matured.

The general construction of the intake structure is shown in *Figs. 5* and *6*. The part between the base and the main floor was divided into a number of compartments by longitudinal and cross walls. These compartments were connected by holes through the walls into six groups, each group being served by two 6-in. valves controlling the passage of water through the external walls. In this way water-ballast could be admitted to correct any tendency of the structure to list. A depth of about 2 ft. 6 in. of 1 : 15 concrete was placed in these compartments towards the end of the construction at Tilbury Docks to maintain stability. After sinking at Coryton these compartments were filled with sand and gravel to provide the necessary weight to resist buoyancy.

Between the main floor and the top slab, partition walls will be required in which penstocks will be fixed to control the passage of water to screens and pumps. These will be built with the structure in its final position, as indicated in *Figs. 5* and *6*; they would have added too much weight at a relatively high level if they had been built while the shell was afloat, and a system of concrete struts and columns (*Fig. 7*) was constructed to resist the water pressure on the

shell. The irregular arrangement of these struts was necessary to clear various fittings to be installed, and in order that they might be enclosed as far as possible within the thickness of the final partition walls. At Coryton the structure will be completed by extending the external walls a further 5 ft., building the internal walls, casting the top platform with its various trenches for pipes and cables, and constructing bases for plant.

The water will be admitted from the river through two openings each 10 ft. square in one side wall, provided with heavy sliding steel screens. It was necessary to close these openings temporarily both for floating the structure and to enable work to be carried on below tide level at Coryton, and for this purpose steel sheet piling was used. The tops of the piles project above low-water level to facilitate their final removal.

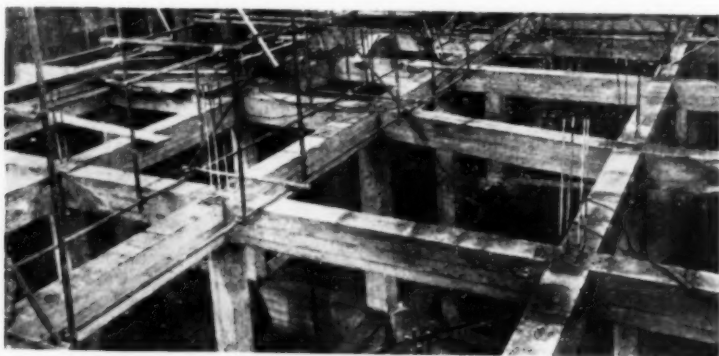


Fig. 7.—Bracing to Resist Water Pressure.

Shuttering for all the walls was of a type which was used successfully for "Phoenix" structures during the war, and its value was again proved. Two lifts of standard panels, 6 ft. long by 2 ft. high, with necessary specials, made of 1½-in. boards on 3-in. by 2-in. frames, were used in a "leap frog" system. The faces were tied together by threaded bars, screwed from either side into nuts welded to a shaped separator and with double nuts outside the shutter framing. Fig. 8 illustrates the method of fixing the shutters.

In the dry dock at Gravesend the concrete was mixed in 14/10 drum mixers and delivered by chute to wheelbarrows for distribution to the walls. At Tilbury Docks, in the earlier stages, concrete was wheeled directly from the mixers, water-ballast being pumped into the structure to maintain the top of the walls at an approximately constant level until a height of 30 ft. 6 in. was reached. The water-ballast was then pumped out, and hopper hoists were used for lifting the concrete for the remainder of the walls. This lowering of the structure in the water also greatly reduced the amount of external scaffolding required for lifting the shutters, as it was possible to do this work from a stage floating on oil drums which was incorporated in a timber fender placed to protect the structure from damage by the craft using the dock.

The proportions of the concrete generally were 3.66 cu. ft. of  $\frac{3}{4}$  in. to  $\frac{3}{16}$  in.



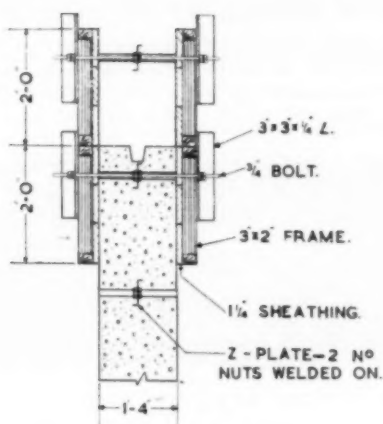


Fig. 8.—Cross Section of Typical Shuttering.

stone, 2.65 cu. ft. of sand, and 112 lb. of cement, and all concrete was vibrated with poker vibrators. During frosty weather the aggregates were steam-heated and, in certain parts which were subjected to early stressing, Portland cement containing calcium chloride was used. Test cubes were made and crushed at regular intervals. The average crushing strength of cubes was 6150 lb. per square inch at 28 days.

The cost of the work has not differed greatly from the estimated cost of more conventional methods, but a saving of time of at least six months has been achieved in spite of some delays in obtaining steel reinforcement. Messrs. John Laing & Son, Ltd., the contractors for the foundations and civil engineering works at the refinery have, in conjunction with the Lummus Company of New York and London (the main contractors to the Vacuum Oil Co.), been responsible for the planning and construction of this structure; Mr. D. N. Mitchell, A.M.Inst.C.E., was in charge of the detailed design work.

### Civil Engineering in the British Colonies.

THE Institution of Civil Engineers is holding the third conference on Civil Engineering in the Colonies in London from June 16 to 20. These conferences are intended to cater for the Colonial Engineering Service and of others engaged in civil engineering work in the British Colonies. Attendance at the conference is not confined to members of the

Institution, and non-members may attend by making application to the Institution. The conference comprises visits to works and technical sessions at which papers will be discussed on road research, railways, water power, and water supply. Further details may be had from the Secretary, Institution of Civil Engineers, Great George Street, London, S.W.1.

## Shell-roof Hangars of 333-ft. Span.

THE roofs of two new hangars of shell construction at Marseilles are described in a recent number of "Le Genie Civil". Each hangar is 333 ft. wide and 193 ft.

height of the structure is about 107 ft. The ties, which are suspended from the vaults at about 33 ft. centres, are of pre-stressed concrete. A novel feature of the



Fig. 1.



Fig. 2.

long, and has a clear height of 62 ft. below the ties at the entrance. The roofs are reinforced concrete parabolic vaults each comprising six secondary vaults 32 ft. wide and about 7 ft. high. The thickness of the shell is generally 2½ in. The total

construction is that each roof was constructed on the ground (Fig. 1) and then raised on jacks to its permanent level (Fig. 2). Sixteen 300-tons jacks and two 100-tons jacks were used, and upward movement was about 3 ft. daily.

## BOOKS ON CONCRETE

For detailed prospectuses of "Concrete Series" books on all aspects of concrete and reinforced concrete design and construction, precast concrete, and cement, send a post-card to

**CONCRETE PUBLICATIONS LIMITED**  
14 DARTMOUTH STREET, WESTMINSTER, S.W. 1

## The Design of Simple and Composite Prestressed Concrete Beams.

By E. W. BENNETT, M.Sc., A.M.Inst.C.E.

THE ultimate moment of resistance of a prestressed concrete beam is governed by the area and position of the tensioned and untensioned wires in the tensile zone, provided that the area of the concrete in compression is sufficient to ensure that failure occurs by extension or fracture of the steel. The working stresses in the concrete, however, depend on the shape and size of the beam and the magnitude and position of the prestressing force. These factors are taken into account in the simple method described of designing symmetrical or unsymmetrical prestressed concrete I-beams and beams made of precast and cast-in-situ parts. A consideration of the ultimate moment of resistance and the factor of safety of prestressed concrete beams, and another method of designing unsymmetrical sections, were given by Dr. P. W. Abeles in this journal for October, 1951, and March, 1952.

### Ordinary Beams.

Formulae for the section moduli  $Z_1$  and  $Z_2$  related to the bottom and top respectively of an unsymmetrical section and obtained from the equations given by Dr. Abeles are

$$Z_1 > \frac{M_w - R_0 M_c}{R_0 f_{ct} + f_{tw}}; \quad Z_2 > \frac{M_w - R_0 M_c}{R_0 f_{2t(lim.)} + f_{cw}} \quad (1)$$

The notation is shown in Fig. 1, or is as follows:  $M_w$ , bending moment due to the working load;  $R_0$ , reduction of prestress in course of time;  $f_{ct}$ ,  $f_{cw}$ , compressive stress permitted when the concrete is put into compression and at working load respectively;  $f_{tw}$ , tensile stress permitted in the concrete at working load. Other symbols are explained in the text.

The bending moment  $M_c$  is the minimum bending moment due to the weight of the beam that may occur during its manufacture, transport and erection. If the beam is always upright and supported at its ends  $M_c = M_s$  for the section at midspan, and  $M_c = -M_s$  if the beam is suspended from the midpoint while upright or supported at its ends while inverted. If the beam is slung at the first and third quarter-points  $M_c = -0.25M_s$  at the slinging points, and zero at midspan.

Having calculated from (1) the minimum section moduli required, a cross section having these values can be designed fairly accurately at the first attempt by using the chart in Fig. 1, which gives the ratios of  $Z_1$  and  $Z_2$  to the section modulus of the circumscribing rectangle for unsymmetrical sections of various proportions. The section selected will generally have values of  $Z_1$  and  $Z_2$  slightly greater than the minima, and the prestress  $f_{1t}$  and  $f_{2t}$  at the bottom and top of the beam at the time the compression is transmitted to the concrete must be between the limits

$$\frac{M_w}{R_0 Z_1} - \frac{f_{tw}}{R_0} < f_{1t} < f_{ct} + \frac{M_c}{Z_1}; \quad \text{and} \quad -\frac{M_c}{Z_2} - f_{2t(lim.)} < f_{2t} < \frac{f_{cw}}{R_0} - \frac{M_w}{R_0 Z_2} \quad (2)$$

The formulae for the magnitude  $P_t$  and eccentricity  $\bar{e}$  of the resultant pre-

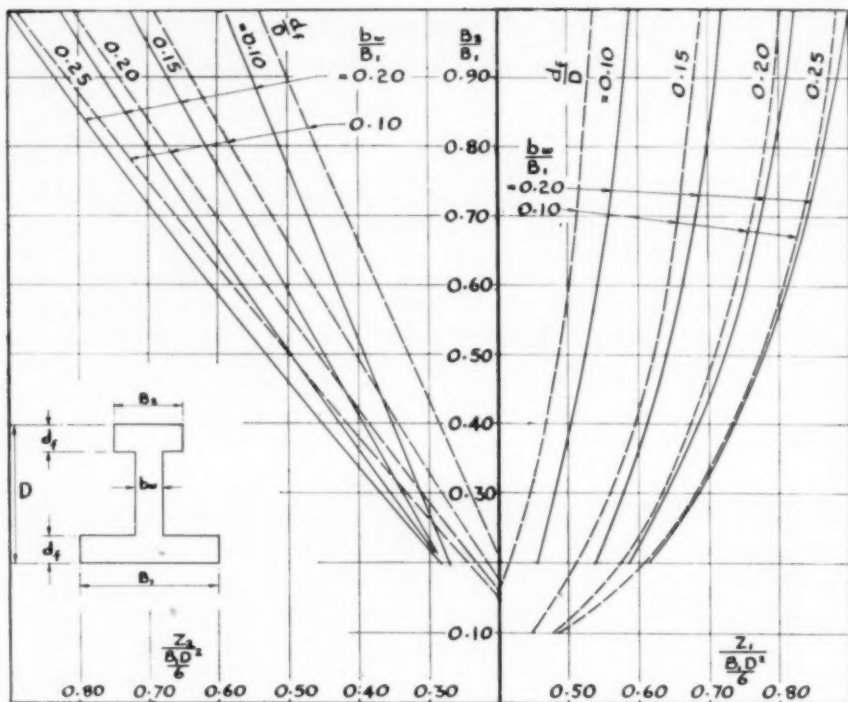


Fig. 1.

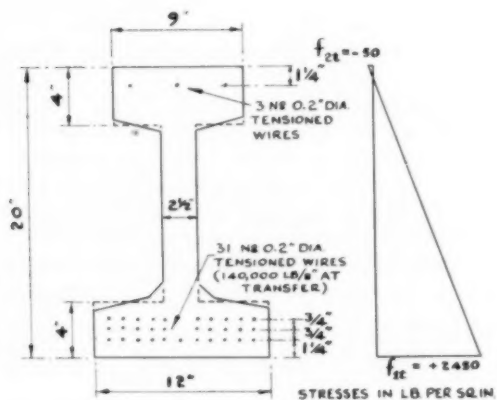


Fig. 2.

stressing force derived from the basic equations for compression and bending of a homogeneous section of area  $A$  are

$$P_t = \frac{A(f_{1t}Z_1 + f_{2t}Z_2)}{Z_1 + Z_2}, \quad \bar{e}_s = \frac{Z_1Z_2(f_{1t} - f_{2t})}{A(f_{1t}Z_2 + f_{2t}Z_1)} \quad (3)$$

The eccentricity  $\bar{e}_s$  is measured from the centroid of the section, and is positive if below the centroid. It is not implied that all the wires must be placed with an eccentricity  $\bar{e}_s$ . To obtain the greatest resistance to failure it is necessary to place as many wires as possible near the bottom of the section, balanced by a smaller number near the top. If  $\bar{N}$  is the total number of wires and the eccentricity of the bottom and top groups is  $e_s$  and  $e'_s$  respectively, then  $N'$ , the number of wires required in the top group, is given by

$$N' = \frac{\bar{N}(e_s - \bar{e}_s)}{e_s + e'_s} \quad (4)$$

EXAMPLE NO. 1.—Design a beam with a maximum breadth of 12 in. and a depth not exceeding 20 in. to resist a bending moment at working load of 1,600,000 in.-lb. Assume that  $M_c = 0$  during erection.

The permissible compressive and tensile stresses in the concrete when it is first compressed are 2500 lb. and 100 lb. per square inch, and at working load 3000 lb. and 500 lb. per square inch, respectively. Assume that  $R_0 = 0.85$ . From (1):

$$Z_1 > \frac{1,600,000 - 0}{(0.85 \times 2500) + 500} > 610 \text{ in.}^3, \text{ and } Z_2 > \frac{1,600,000 - 0}{(0.85 \times 100) + 3000} > 519 \text{ in.}^3.$$

The section-modulus ratio for  $Z_1$  is  $\frac{610 \times 6}{12 \times 20^2} = 0.76$ ; for  $Z_2$  it is  $\frac{519 \times 6}{12 \times 20^2} = 0.65$ .

From Fig. 1 slightly greater values are obtained if  $\frac{d_f}{D} = 0.20$ ,  $\frac{b_w}{B_1} = 0.20$ , and

$\frac{B_2}{B_1} = 0.75$ . The dimensions of a suitable section are therefore as in Fig. 2,

the properties of this section being:  $Z_1$ , 628 in.<sup>3</sup>;  $Z_2$ , 532 in.<sup>3</sup>;  $A$ , 114 in.<sup>2</sup>; position of centroid 9.18 in. from the bottom. Hence  $e_s = 9.18 - 2.0 = 7.18$  in., and  $e'_s = 20 - 9.18 - 1.25 = 9.57$  in.

$$\text{From (2), } \frac{1,600,000}{0.85 \times 628} - \frac{500}{0.85} < f_{1t} < 2500 + 0; \text{ therefore } 2412 < f_{1t} < 2500.$$

$$\text{From (2), } 0 - 100 < f_{2t} < \frac{3000}{0.85} - \frac{1,600,000}{0.85 \times 532}; \text{ therefore } -100 < f_{2t} < -10.$$

Suitable values of the prestress between these limits are  $f_{1t} = 2450$  lb. per square inch and  $f_{2t} = -50$  lb. per square inch. From (3),

$$P_t = \frac{114[(2450 \times 628) - (50 \times 532)]}{628 + 532} = 149,000 \text{ lb.},$$

which can be provided by 34 0.2-in. diameter wires with a stress of 140,000 lb. per square inch when the concrete is put into compression.

$$\text{From (3), } \bar{e}_s = \frac{628 \times 532[2450 - (-50)]}{114[(628 \times -50) + (532 \times 2450)]} = 5.75 \text{ in.}$$

$$\text{From (4), } N' = \frac{34(7.18 - 5.75)}{7.18 + 9.61} = 2.90,$$

that is three wires should be in the top and 31 wires in the bottom, which when arranged as in Fig. 2 have an eccentricity  $\bar{e}_s$  of 5.72 in.

### Composite Beams.

The following notation is used.  $Z'_1$  and  $Z'_2$ , section moduli of composite section related to bottom and top respectively of the precast beam;  $Z'_3$  and  $Z'_4$ , section moduli of composite section related to bottom and top respectively of the cast-in-situ concrete;  $f_{cw}$  and  $f_{tw}$ , permissible compressive and tensile stresses respectively in the cast-in-situ concrete at working load;  $M$ , bending moment applied to the precast beam, acting alone, due to its own weight and the weight of the wet cast-in-situ concrete;  $M'$ , additional bending moment applied after the cast-in-situ concrete has hardened and acts with the precast beam as a composite member.

For the bottom of the beam the basic conditions are

$$f_{1t} - \frac{M_c}{Z_1} < f_{ct}, \text{ and } R_0 f_{1t} - \frac{M}{Z_1} - \frac{M'}{Z'_1} > -f_{tw}.$$

Attention must be paid to the signs  $f_{ct}$ ,  $f_{cw}$ ,  $f_{2t(lim.)}$ , and  $f_{tw}$  being positive. From these expressions and similar expressions for the top of the precast beam and the top and bottom of the cast-in-situ concrete:

$$\left. \begin{aligned} Z'_1 &> \frac{Z_1 M'}{Z_1(R_0 f_{ct} + f_{tw}) - (M - R_0 M_c)}; & Z'_3 &> \frac{M'}{f_{tw}} \\ Z'_2 &> \frac{Z_2 M'}{Z_2(f_{cw} + R_0 f_{2t(lim.)}) - (M - R_0 M_c)}; & Z'_4 &> \frac{M'}{f_{cw}} \end{aligned} \right\} \quad (5)$$

Formulae (1), which gives the minimum moduli for an ordinary beam, are replaced by formulae (5) relating  $Z_1$  and  $Z_2$  to  $Z'_1$  and  $Z'_2$ , the values of which can be determined when  $Z_1$  and  $Z_2$  are known, such as is the case when calculating the required size of a composite section containing a precast beam of known size.

In some cases there may be conditions governing the stresses due to dead load or live load, for example  $f_{tw}$  may be zero due to the dead load and 500 lb. per square inch due to the total load. In such cases formulae (5) may have to be solved separately for each condition and the section designed to give a modulus not less than the greatest value of  $Z'$ . In other cases the overall dimensions of the composite section may be fixed, and it is then necessary to calculate the size of the precast beam required, for which purpose formulae (5) are more conveniently expressed thus:

$$Z_1 > \frac{Z'_1(M - R_0 M_c)}{Z'_1(R_0 f_{ct} + f_{tw}) - M'}; \quad Z_2 > \frac{Z'_2(M - R_0 M_c)}{Z'_2(f_{cw} + f_{2t(lim.)}) - M'} \quad (6)$$

The expressions for the stresses ( $f_{1t}$  and  $f_{2t}$ ) at the bottom and the top of the precast beam when the concrete is put into compression, that is "at transfer," are

$$\left. \begin{aligned} \frac{M}{R_0 Z_1} + \frac{M'}{R_0 Z'_1} - \frac{f_{tw}}{R_0} &< f_{1t} < \frac{M_c}{Z_1} + f_{ct}; \\ \text{and } -\frac{M_c}{Z_2} - f_{2t(lim.)} &< f_{2t} < -\frac{M}{R_0 Z_2} - \frac{M'}{R_0 Z'_2} + \frac{f_{cw}}{R_0} \end{aligned} \right\} \quad (7)$$



When the required prestress has been calculated, the number and position of the wires in the precast beam can be calculated from (3) and (4) as for an ordinary beam.

EXAMPLE NO. 2.—The thickness of the cast-in-situ slab is to be determined if a 9-in. by 3-in. rectangular precast beam is incorporated in a composite tee-section 15 in. wide which is to carry a uniformly-distributed load of 135 lb. per square foot, the span being 20 ft. The wires required in the precast beam are also to be determined. The permissible compressive stresses in cast-in-situ and precast concrete are 1000 lb. and 3000 lb. per square inch respectively. There must be no tensile stress when the concrete is put into compression, nor due to the working load. Assume that  $R_0$  is 0.85 and that the precast beam may be handled in any position.

$$M_c = - \left( \frac{9 \times 3}{144} \times 150 \right) \left( \frac{20^2 \times 12}{8} \right) = -16,800 \text{ in.-lb.}$$

Assuming that the

weight of the composite beam is 45 lb. per foot,  $M = 45 \times \frac{20^2}{8} \times 12 = 27,000 \text{ in.-lb.}$ ,

$$\text{and } M' = \left( 135 \times \frac{15}{12} \right) \left( \frac{20^2}{8} \times 12 \right) = 102,000 \text{ in.-lb.}$$

$$Z_1 = Z_2 = \frac{3 \times 9^2}{6} = 40.5 \text{ in.}^3 \quad \text{From formulæ (5)}$$

$$Z'_1 > \frac{40.5 \times 102,000}{40.5[(0.85 \times 3000) + 0] - [27,000 + (0.85 \times 16,800)]} > 67.1 \text{ in.}^3$$

$$Z'_2 > \frac{40.5 \times 102,000}{40.5(3000 + 0) - [27,000 + (0.85 \times 16,800)]} > 51.5 \text{ in.}^3$$

$$Z'_4 > \frac{102,000}{1000} > 102 \text{ in.}^3$$

The ratios of the section moduli vary according to the overall depth of the beam, and several trials should be made. With a depth of 10 in. the ratios are 0.27 for  $Z'_1$  and 0.41 for  $Z'_4$ . From Fig. 1 the section in Fig. 3 may be selected, for which the section moduli are  $Z'_1$ , 68 in.<sup>3</sup>;  $Z_2$ , 156 in.<sup>3</sup>; and  $Z_4$ , 114 in.<sup>3</sup>

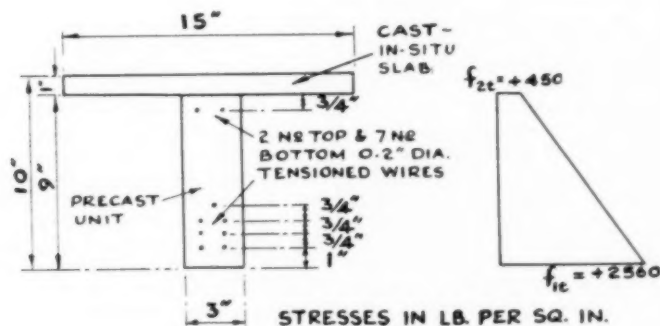


Fig. 3.

The limits of the prestress as given by (7) are

$$\frac{27,000}{0.85 \times 40.5} + \frac{102,000}{0.85 \times 68} - 0 < f_{1t} < -\frac{16,800}{40.5} + 3000;$$

that is  $2550 < f_{1t} < 2585$  lb. per square inch.

$$+\frac{16,800}{40.5} - 0 < f_{2t} < -\frac{27,000}{0.85 \times 40.5} - \frac{102,000}{0.85 \times 156} + \frac{3000}{0.85};$$

that is  $415 < f_{2t} < 1975$  lb. per square inch.

Selecting  $f_{1t} = 2560$  lb. and  $f_{2t} = 450$  lb. per square inch and substituting in (3),  $\bar{P}_t$  is 40,600 lb., which is provided by nine 0.2-in. wires at a stress of 140,000 lb. per square inch;  $\bar{e}_s = 1.05$  in. Therefore  $e_s = 4.50 - 1.75 = 2.75$  in., and  $e'_s = 4.50 - 0.75 = 3.75$  in. From (4),  $N'$  is 2.36; two wires are therefore placed at the top and seven at the bottom of the beam.

EXAMPLE No. 3.—It is required to design a precast beam 20 in. deep to be used in a rectangular composite beam 24 in. deep and 12 in. wide. The bending moment  $M'$  to be resisted is 1,255,000 in.-lb. and the span is 44 ft. The permissible stresses in the precast concrete are as in Example No. 1, and the compressive stress in the cast-in-situ concrete must not exceed 1200 lb. per square inch.

$$M = \left( \frac{24 \times 12}{144} \times 150 \right) \left( \frac{44^2}{8} \times 12 \right) = 870,000 \text{ in.-lb.}$$

$$Z'_1 = Z'_4 = \frac{12 \times 24^2}{6} = 1152 \text{ in.}^3; \quad Z'_2 = 1152 \times \frac{12}{8} = 1728 \text{ in.}^3$$

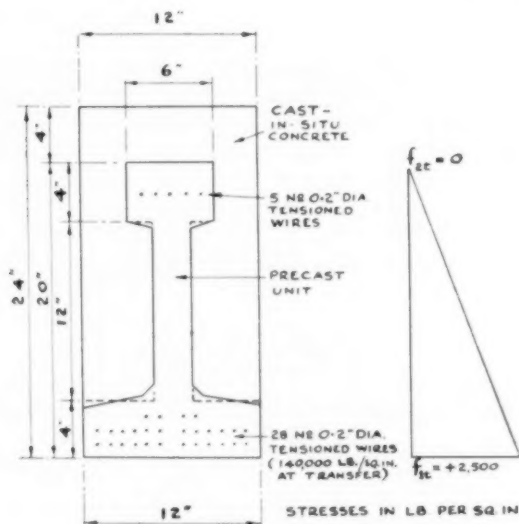


Fig. 4.

From formulæ (6)

$$Z_1 > \frac{1152(870,000 - 0)}{1152[(0.85 \times 2500) + 500] - 1,255,000} > 565 \text{ in.}^3$$

$$Z_2 > \frac{1728(870,000 - 0)}{1728[3000 + (0.85 \times 100)] - 1,255,000} > 368 \text{ in.}^3$$

From formula (5),

$$Z'_4 > \frac{1,255,000}{1200} > 1045 \text{ in.}^3$$

Since  $\frac{6}{12 \times 20^2} = \frac{1}{800}$ , the ratios of the section moduli are  $\frac{565}{800} = 0.71$  for

$Z_1$ , and  $\frac{368}{800} = 0.46$  for  $Z_2$ . From Fig. 1 the values  $\frac{d_f}{D} = 0.20$ ,  $\frac{b_w}{B_1} = 0.20$ , and

$\frac{B_2}{B_1} = 0.50$  give ratios of 0.72 and 0.49 respectively. Hence the dimensions of

the section may be as in Fig. 4. The accurate section moduli are  $Z_1 = 579 \text{ in.}^3$  and  $Z_2 = 395 \text{ in.}^3$ . The area  $A$  is 102 in.<sup>2</sup> and the centroid is 8.11 in. from the bottom, so that  $e_s = 8.11 - 1.75 = 6.36 \text{ in.}$  and  $e'_s = 20.0 - 8.11 - 2.0 = 9.89 \text{ in.}$  From formulæ (7), suitable values of the prestress when the concrete is put into compression are  $f_{1t} = 2500 \text{ lb. per square inch}$  and  $f_{2t} = 0$ . From formulæ (3), and (4),  $P_t$  is 145,000 lb., which is provided by thirty-three 0.2-in. wires,  $\bar{e}_s = 3.87 \text{ in.}$ , and  $N' = 5.06$ . Therefore there should be five wires at the top and twenty-eight at the bottom as in Fig. 4.

## Book Reviews.

**"Coast Erosion and Protection."** By R. R. Minikin.  
(London: Chapman & Hall, Ltd. Price 30s.)

THIS book is useful to engineers concerned with either new work or the maintenance of existing work bordering on the open sea. The illustrations and examples are primarily taken from Britain and the near-by coastline of the Continent, but the author's opinions and comments, even if in some cases controversial, are well explained and of wide application. The book gives hardly any formulæ or analytical treatment of wave action, littoral drift, or the constructional work of coast protection; it is primarily descriptive, supplemented by constructive criticism. It is easy to read, and illustrated by some 200 photographs and diagrams. This subject has been only scantily treated in recent years, and the history of coast erosion and protection in some areas indicates that more information cannot be superfluous. The omission of references or a bibliography could well be rectified should a later edition be

printed, so that readers will be guided to the source of further information on the problems and examples dealt with by the author.—D. L.

**"System of Tables for Quick and Accurate Solving of any Continuous Beam."** By A. F. Skayannis.  
1949. (London: Lange, Maxwell & Springer. Price 21s.)

THIS is an English translation of a booklet originally published in the Greek language. Starting with a known condition at the left-hand end of a series of spans, the table or graph is used to calculate successive "fixed point positions" at the left end of each span. The operation is repeated from the right-hand end of the series of spans. Taking each loaded span separately, by using one of the tables, from the left and right "fixed point positions" are obtained the left and right support moments. The resultant support moments may then be obtained by adding the loads on each span.

If the words "degrees of fixity" are substituted for "fixed point positions"

the method seems to be one which has been in use in this country for more than ten years, and which is explained in relation to beams and frames, with "short-cut" solutions for special cases, in a book entitled "Continuous Beam Structures: The Degree of Fixity Method" by E. Shepley. For those who prefer tables to graphs, these tables are immediately adaptable to the degree of fixity method by the simple con-

version  $a = \frac{f}{f+2}$ . The tables are clearly printed and deal with all cases of uniform and concentrated loading on any system of continuous prismatic spans.

"**Anschauliche Verfahren zur Berechnung von Durchlaufbalken und Rahmen**" (Ausgleichverfahren). By R. v. Halasz. (Berlin: Wilhelm Ernst & Sohn, 1951. Price 31.50 D.M.)

METHODS of calculation of continuous beams and frames by the dispersal of residual fixity moments through successive approximations where the same routine, which is largely self-checking, applies to all types of structures, are, according to the author, being widely

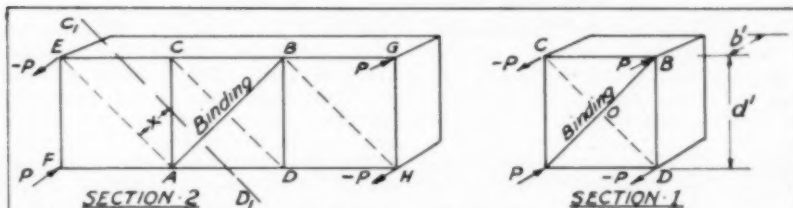
adopted on the Continent. It is claimed that much of the arithmetical work can be done by partly-trained staff under the supervision of an experienced engineer. The author gives a summary of the methods originated by Professor Hardy Cross, and their use is illustrated by examples. However, in the method suggested great care must be taken in establishing the correct values of moments and forces in complicated frames subject to sway, and under such conditions it is likely that some of the more familiar methods give quicker results. Many useful diagrams are given for the calculation of beams with haunches at one or both supports, and of beams having varying moment of inertia throughout. Values of the support moments for uniformly, partially, and fully distributed loads are given, and for concentrated loads in any position suitable for the construction of influence lines. Diagrams are also given for stiffness and dispersal coefficients. With these data the method can be readily applied to beams of varying moment of inertia without much extra work.

### Design of a Bow Girder.

IN response to inquiries regarding the formulæ given in the article in our February number on "The Design of an Unusual Bow Girder", in which spiral reinforcement was used to resist torsion, the author of the article, Mr. V. A. Morgan, M.Eng., has prepared the notes on the facing page.

The concrete, as well as the binding wire, resists the shearing force, which is greatest at the centre of the longer side and less at the shorter side. However, after the concrete has cracked the variation of stress in the uncracked concrete is not the same as in the steel binding wire. Mr. F. B. Seely, in "Advanced Strength of Materials", assumes a rather approximate parabolic variation with a maximum stress of 1.5 times the average as against  $\sqrt{2}$  times assumed by Rausch, whereas the solution derived by St. Venant has a much wider variation and is much more related to the results of experiments. The much simpler formula for  $s_1$  given in the article gives results which are almost identical with St. Venant's within the common range of  $d/b$ .

It can be shown that the effect of torsion is to twist the top of the beam outwards and away from the centre of the curve. This can be proved by substituting the values of  $M_K$ ,  $W_F$ , and  $h_F$  in equation (2a) in the article for the torsion in the straight part BP of the beam. Inward twisting is caused by the load  $W_F$  acting at an eccentricity  $h_F$ , but  $\frac{M_K}{\sqrt{2}}$ , causing outward twisting, is greater than the inward torsional moment; hence the top of the beam tends to twist outwards and away from the centre of curvature. A similar result for the torsion acting on the curved part is obtained by substitution in equation (2).



To show that the bending moment is uniform along binding wire AB.

FOR CENTRAL SECTION 1:

Loads  $P$  acting at A and B produce a moment on the fulcrum diagonal CD which causes a tensile stress in the binding wire at O, which as the tensile strength of the concrete is neglected, is resisted by the binding, the moment being  $\frac{Pd'}{\sqrt{2}} = \frac{I}{\sqrt{2}}$

FOR SECTION 2:

A length  $3d'$  of the beam (in torsion)

This section is acted on by four forces, two positive at F and G and two negative  $-P$  at E and  $-P$  at H.

(1) Moments about CD causing rotation perpendicular to CD.

$$= P(at F) \times \frac{2d'}{\sqrt{2}} - P(at E) \frac{d'}{\sqrt{2}} = \frac{Pd'}{\sqrt{2}} = \frac{I}{\sqrt{2}} \text{ as for the central section 1.}$$

(2) Moments about any intermediate line (C, D<sub>1</sub>) parallel to CD between A and B distant  $x$  from EA:

$$M = P(\frac{d'}{x} + x) - Px = \frac{Pd'}{\sqrt{2}} \text{ as for the diagonal CD.}$$

There is therefore a uniform moment of  $\frac{I}{\sqrt{2}}$  producing a uniform tensile stress in the binding from A to B (as the binding resists the tensile stress and the tensile strength of the concrete is neglected). In a similar manner it can be shown that where the binding crosses the short side  $b'$  of the girder the moment resisted by the diagonal wire is  $\frac{Pb'}{\sqrt{2}} = \frac{I}{\sqrt{2}}$  and is uniform along the diagonal.

To show why the assumption was made that the maximum stress in the binding is  $\sqrt{2}$  times the average stress.

As  $b'$  is assumed to be the breadth of the shorter side, the stress in the wire at the longer side is greater than at the shorter side and the wire graduates from a maximum at the centre of the longer side to a minimum at the centre of the shorter side. The maximum stress is assumed to be :-

$$t_{\max} = \frac{I}{\sqrt{2}b'A_b} \text{ and } t_{\text{average}} = \frac{1}{2}(\frac{I}{\sqrt{2}b'A_b} + \frac{I}{\sqrt{2}d'A_b}) \text{ and } \frac{t_{\max}}{t_{\text{avg}}} = (\text{after cancelling out and reducing}) \frac{2d'}{b' + d'}$$

Thus for a range of values  $\frac{d'}{b'} = 1$  to  $\frac{d'}{b'} = 5$

$\frac{d'}{b'} = 1$	2	3	4	5
$\frac{t_{\max}}{t_{\text{avg}}}$	1.33	1.5	1.6	1.66

Thus the arithmetical mean of these five values. (the common range in practice.)  
 $= \frac{7.09}{5} = 1.418 = \sqrt{2}$  very nearly.

This formula is only a design formula and is to cover, with a safety margin, many possible variations in construction, concrete mixtures etc. Other formulae with varying constants for the range of  $d'/b'$  from 1 to 5 could be used if desired. There is, according to Marshall and Tembe ("Structural Engineer", November 1941) a factor of safety of 4 on the ultimate steel stress for Rausch's formula, so that there is an adequate safety margin.

Design of a Bow Girder. (See facing page.)

**Cooling Concrete in a Dam.**

A DAM now being built at Warragamba, New South Wales, Australia, will be 1300 ft. long and 350 ft. high and will contain 1,500,000 cu. yd. of concrete which it is planned to place at the rate of 2000 cu. yd. per day. The dam is a straight gravity structure, and will have longitudinal and transverse construction joints at intervals of 50 ft. The structure will thus comprise a number of independent prisms which will be grouted together later. According to the "Commonwealth Engineer" for June, 1951, from which the following is abstracted, this form of construction has been adopted to avoid cracking in the concrete due to heat generated during the hydration of the cement.

A system of cooling pipes will be embedded in the concrete, and chilled water will then be circulated through the pipes to bring the concrete to its final temperature. To supplement the cooling pipes the temperature of the concrete will be maintained at 55 deg. F. when it is placed. During the summer most of the mixing water will be added in the form of ice and the remainder will be chilled to 34 deg. F. The maximum ice content will be 132 lb. per cu. yd. of concrete. The concrete will contain stones up to 6 in. maximum size and have a water-cement ratio by weight of 0.58. A plant

capable of producing 170 tons of ice and 10,000 gallons of water per day at 34 deg. F. will be used. The ice must be of such size and shape that it can be readily conveyed and weighed and it must be small enough to fragment and thoroughly melt during the three minutes' mixing period. Also, it must be possible to alter the output quickly to suit the rate of placing concrete.

A contract has been awarded to J. Budge Pty., Ltd., and the H. Vogt Machine Co. of the U.S.A. for a refrigeration plant to cost about £90,000, and the plant was expected to be in operation early in 1952. Three tube-ice machines will be installed. The ice will be first produced in the form of hollow tubes having a wall thickness of  $\frac{3}{8}$  in., which will be crushed into segments about 1 in. long. The machines will be housed in a tower adjacent to the concrete mixers. As the ice is produced it will fall into hopper-bottomed storage bins capable of storing 60 tons of ice, from whence it will be taken by a screw conveyor to the mixing tower where it will be automatically weighed and emptied into the concrete mixer.

A water cooler of 4500 gallons capacity will be installed to deliver water at 34 deg. F. to the concrete mixer and the ice machines.

## THE DISPLACEMENT METHOD OF **FRAME ANALYSIS**

By G. P. MANNING, M.Eng., M.Inst.C.E.

128 pp. 88 illustrations. 19 tables. Price 9s.; by post 9s. 9d. 2.10 dollars in Canada and U.S.A.

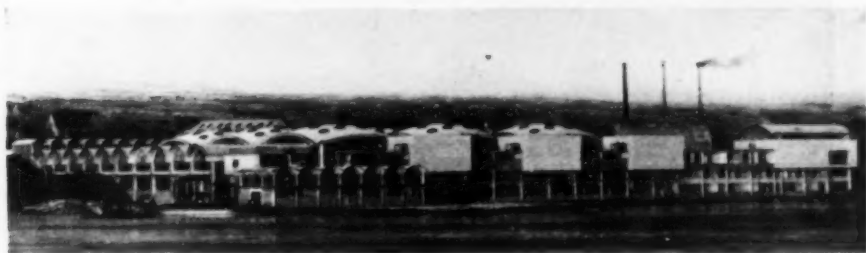
Full details and many examples of the application of the "Displacement Method" of analysis of indeterminate frames, which has been proved in practice in a large design office for more than fifteen years. This labour-saving method can be applied to simple and complex frames, closed frames, and continuous beams of constant and non-constant section. Solutions are obtained by slide-rule, time is saved and the risk of errors is reduced.

(1) Full discussion of the principles of the Displacement Method. (2) Application, with examples, of the method to—(i) Rectangular frames with members of constant section; (ii) Frames with sloping members of constant section; (iii) Multiple-bay and multiple-story frames with members of constant section; (iv) Settlement and shrinkage; (v) Simple frames with members of non-constant section; (vi) Brackets on columns; (vii) Complex frames with members of non-constant section; (viii) Continuous beams. (3) Tables for fixed-end bending moments and shearing forces and elastic constants for members of constant section, for members with parabolic soffits, straight splays, curved splays, deep ends, or uniform taper, and for members with two parts of constant section.

**CONCRETE PUBLICATIONS LIMITED**  
14 Dartmouth Street, London, S.W.1, England



## Factory at Brynmawr, South Wales.



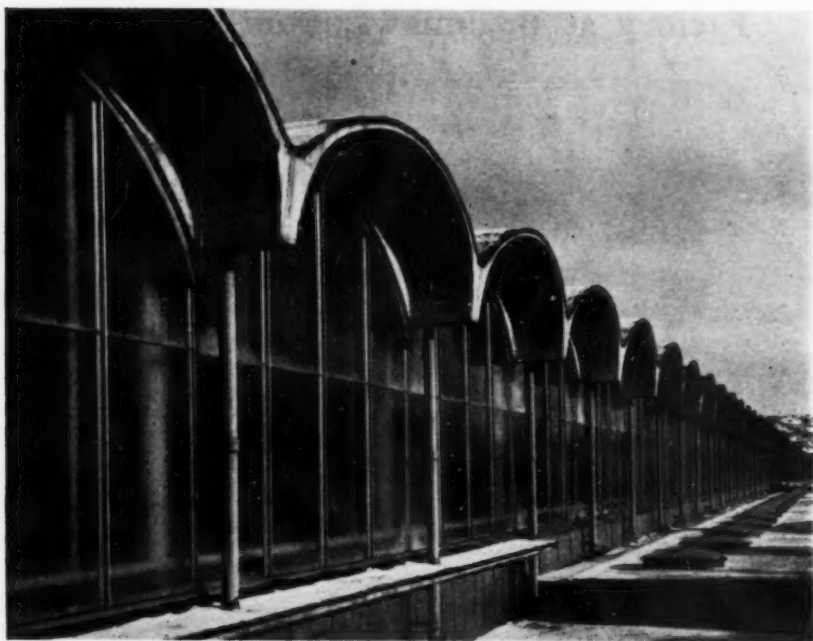
VIEW FROM THE SOUTH.



THE MAIN PRODUCTION AREA.

(A DETAIL OF THE COLUMNS SUPPORTING THE DOMES IS GIVEN ON PAGE 154.)

On this and the following pages are given some photographs of the factory for the Brynmawr Rubber Co., Ltd., which is now completed. The structure was illustrated and fully described in this journal for September 1949, when it was under construction. The main building covers an area of 325 ft. by 450 ft., and is notable for the free use of thin barrel-vault roofs and thin "shell" domes. The floor of the main building is of flat-slab construction, the columns of which are carried on piles. The Architects' Co-operative Copartnership were the architects, and Messrs. Ove Arup & Partners the consulting engineers. The foundation work was carried out by the Cementation Co., Ltd., and the remainder of the work was done by Messrs. Gee, Walker and Slater, Ltd., and Messrs. Holland & Hannen and Cubitts, Ltd.



THE UPPER FLOOR OF THE DRUG ROOM.



INTERIOR OF DRUG ROOM.

Factory at Brynmawr, South Wales. (See p. 151.)



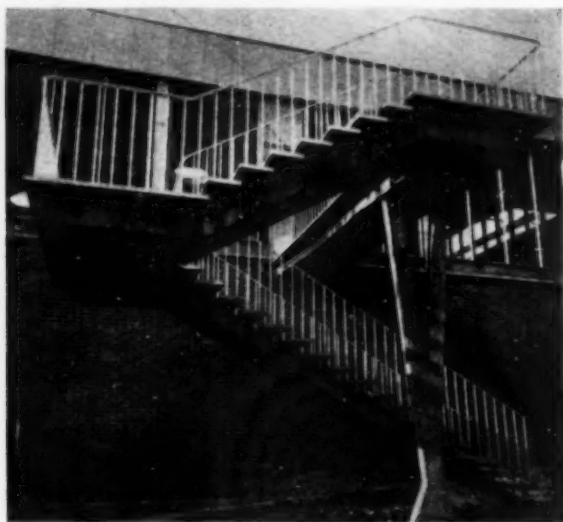
END OF RAMP AT MAIN ENTRANCE.



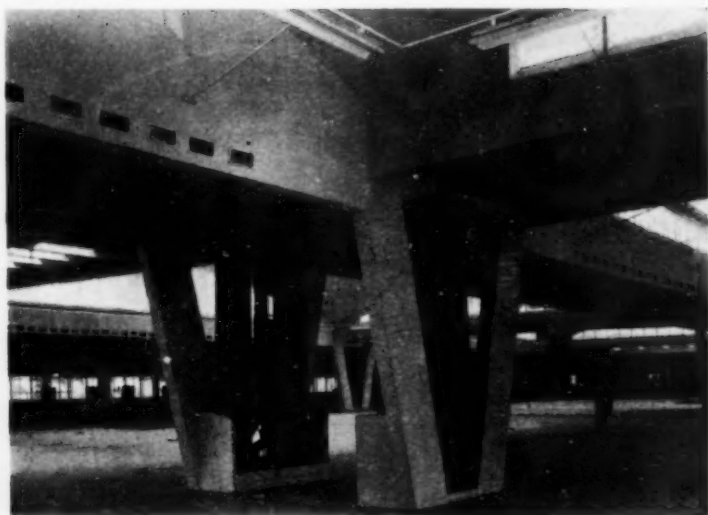
RAMP TO MAIN ENTRANCE.

Factory at Brynmawr, South Wales. (See p. 151.)

May, 1952.



AN ESCAPE STAIRCASE.



RAKING COLUMNS AT INTERSECTION OF DOMES, AND SERVICE PIPES RISING TO OVERHEAD DUCTS.

Factory at Brynmawr, South Wales. (See p. 151.)

## Consolidation of Concrete in Roads and Runways.

THE method of consolidating the concrete in the runway at the Munich-Riem airport in Germany is described by Ing. W. Tzschentke in "Strasse und Autobahn" for August 1951. The slab is 12 in. thick, and in parts 16 in. thick. At first the concrete was laid in three layers of  $4\frac{1}{2}$  in.,  $4\frac{1}{2}$  in., and  $2\frac{1}{2}$  in., but this method required three sets of concrete mixing and placing plants, and there was a considerable interval between the laying of the bottom course and the completion of the joints in the top course. Also, the compacting of the lower layers was hindered by the joints and dowels which occurred at intervals of 25 ft. because the screed and vibrating tamper had to be lifted at each joint and lowered again beyond, and the concrete near the dowels had to be separately compacted. The compaction of the concrete in two layers each of 6 in. could not be carried out as the reinforcement was to be  $2\frac{1}{2}$  in. below the upper surface.

The slab was laid with a bottom course of  $9\frac{1}{2}$  in., on which the reinforcement was placed, and a top course  $2\frac{1}{2}$  in. thick. The slab was 25 ft. wide. The lower course was compacted with vibrators of the



Fig. 1.

poker type, which were pulled through the concrete. Vibrators with a frequency of 9000 vibrations per minute were used, and it was found possible to achieve complete compaction to a depth of  $9\frac{1}{2}$  in. For this purpose, the vibrators were set 2 ft. apart and 1 ft. from the edge of the longitudinal joint, so that there were six vibrators over a width of 12 ft. 6 in. The



Fig. 2.—Vibrators Suspended from Bridge over Road.

leads to the vibrators and the transformer were mounted on a movable cradle on a carriage 25 ft. wide moving on rails. The advantage of the movable cradle was that, by moving the cradle across the width of the 25 ft. wide runway, the work could be done by six vibrators covering 12 ft. 6 in. The compaction of the lower course of one of the four runways was successfully done by three passages of the machine with the vibrators at different depths each time. For the construction of a runway 25 ft. wide only the following were necessary: 1 mixer for the bottom course, 1 spreader, 1 carriage with a movable cradle and six vibrators, and 1 mixer, 1 spreader, and 1 finisher for the top course.

This use of internal vibrators necessitated a wetter concrete than usual. The water-cement ratio for the lower course was increased from about 0.44 to 0.48, and this concrete could, after the passage of the vibrators, be walked on without noticeable marks remaining on the surface. The speed of compaction was

about 1 yard per minute; the two courses were therefore compacted at the rate of about 1 yard in two minutes. Including the compaction around the dowels at the joints and changing for the forward and backward passes the position of the cradle carrying the vibrators, the average time of construction was between 6 and 7 minutes per yard. Cores cut from the runway showed that the bond between the two courses was good.

The vibrators had at first a tendency to work to the surface, and three men each looked after two vibrators and kept a distance of 2 ft. between them (*Fig. 1*). In future provision is to be made for a suspension mechanism on the cradle to keep the vibrators at a constant depth and spacing, so that the vibrators as well as the cradle and stage can be looked after by one man (*Fig. 2*).

The surface of the bottom course was smooth and the reinforcement was placed directly on it. The top course  $2\frac{1}{2}$  in. thick was finished by a high-frequency vibratory screed.

## Steel Removed from Prestressed Piles.

EXPERIMENTS have been made by a firm of contractors, Ben C. Gerwick, Inc., of San Francisco, on the possibility of driving prestressed concrete piles and removing the steel in cases where the piles will not be subjected to bending stresses when they are in place. The following notes on the experiment are from "Engineering News-Record" for January 10, 1952.

The test piles were 18 in. by 18 in. in cross section. The length is not stated, but from a photograph they appear to be about 30 ft. long. A test pile was prestressed with four 1-in. diameter mild steel bars which were placed loosely in metal or paper sleeves cast in the concrete. Threaded ends of the bars projected at each end of the pile and were fitted with plate washers and nuts. When the concrete had reached sufficient strength the nuts were tightened by a wrench to produce in the concrete a compressive stress of 136 lb. per square inch. This pile was lifted by attachments at three points in its length and driven to refusal.

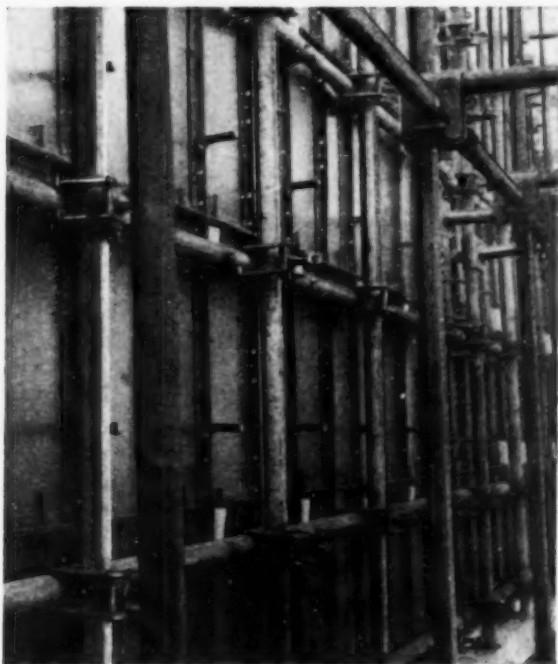
A similar pile was lifted at a single point 9 ft. from the end. In this case the bars were tensioned to produce a compressive stress in the concrete of only 82 lb. per square inch. In neither case did any cracks appear in the piles while they were lifted. The concrete was in the proportions of 560 lb. of cement per cubic yard, and the compressive strength at 28 days was from 3500 to 4500 lb. per square inch. A wooden cushion, in which the protruding ends of the prestressing bars fitted, was used at the top of the piles.

When the piles were driven, the nuts were removed at the top end of the bars. The ends of the bars above the threaded part were of square section so that a spanner could be used to turn the bars and release them from the nuts at the bottom of the pile. The only steel left in the ground were the nuts and washers at the bottom of the piles. No mention is made of the shape of the lower end of the pile, or of whether a shoe was used.



# STEEL FORMS

The Multiple System of Interlocking  
**STEEL SHUTTERING**  
for in-situ concrete construction



**GUARANTEED HAND RIVETED CONSTRUCTION  
THROUGHOUT**

ENORMOUS STRENGTH ALTHOUGH LIGHT IN WEIGHT

ENGINEERED WITH ACCURACY AND PRECISION

BUILT LIKE A SHIP FOR ENDURANCE

EACH UNIT A COMPLETE ASSEMBLY

NO LOOSE PARTS — LOW MAINTENANCE

POSITIVELY NO WELDING

YEARS OF HEAVY USAGE

**A. A. BYRD AND CO., LIMITED**

210, Terminal House, Grosvenor Gardens, London, S.W.1

\*Phone : SLOane 5236.

\*Grams : Byrdicom, Wesphone, London.



## *-there's SGB again!*

Here, there and everywhere you see the sign of SGB—the efficient SCAFFOLDING SERVICE that saves time, money and labour throughout the country. Give SGB your SCAFFOLDING problems. Write or 'phone for details—

### **SCAFFOLDING (GREAT BRITAIN) LIMITED**

MITCHAM • SURREY

Telephone : MITCHAM 3400 (18 lines)    Telegrams : SCAFCO, MITCHAM

Branches at : ABERDEEN • BIRMINGHAM • BOURNEMOUTH • BRIGHTON  
BRISTOL • CAMBRIDGE • CARDIFF • DOVER • DUBLIN • DUNDEE  
EDINBURGH • EXETER • GLASGOW • HULL • LEEDS  
LIVERPOOL • MANCHESTER • NEWCASTLE • NOTTINGHAM • OXFORD  
PLYMOUTH • PORTSMOUTH • SOUTHAMPTON • STOKE-ON-TRENT • SWANSEA



*-the originators of tubular scaffolding!*

## A German Method of Shuttering.

A METHOD of composite steel and wooden shuttering, devised by A. Gattner and described in a recent number of "Beton-

und Stahlbetonbau", is illustrated in Fig. 1, in which the shuttering is applied to (A) floors, (B) columns, and (C) walls.

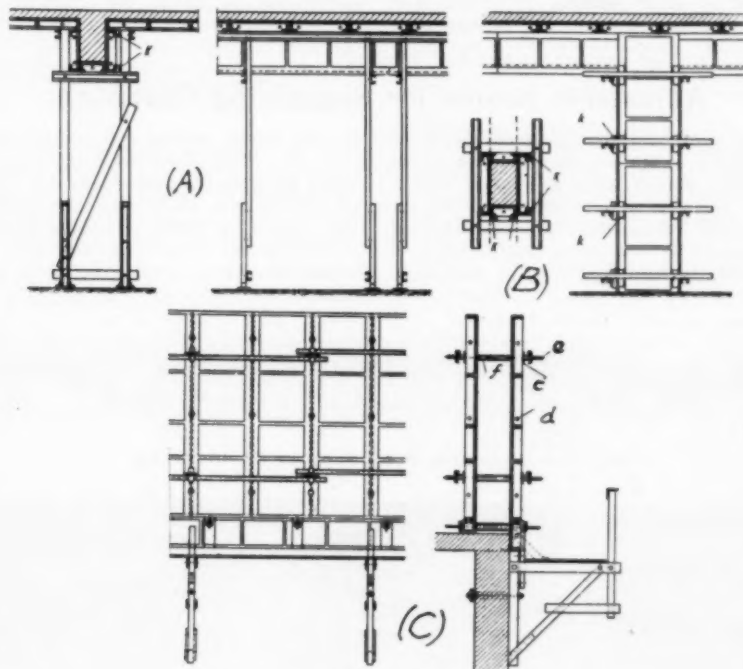


Fig. 1.

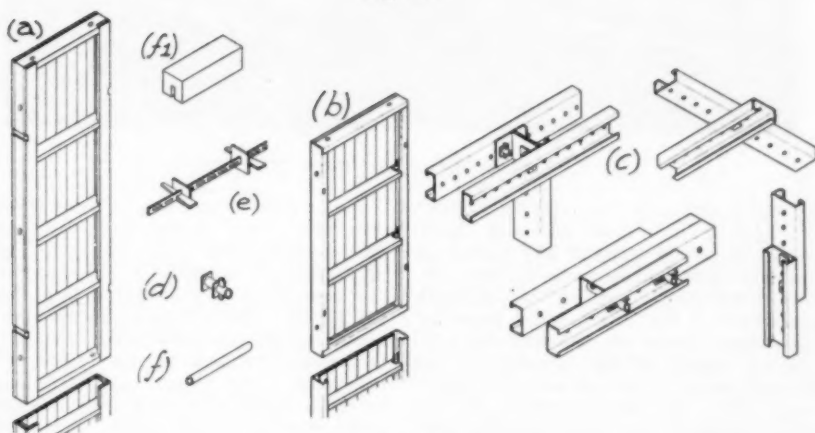


Fig. 2.

Details are shown in *Fig. 2*. The panels comprise wrought timber boards attached to a timber frame as at (a) or to a light steel frame as at (b). Shaped steel bearers and posts, shown at (c), are perforated at close centres to enable the shuttering to be used for members of

different sizes. Timber wedges (k) are used. The parts are fixed together by tubular cotter-bolts (d) and wedged clamps (e) used in conjunction with steel spacers (f) or concrete spacers (f1). The shuttering is made by Siemens-Bau-Union.

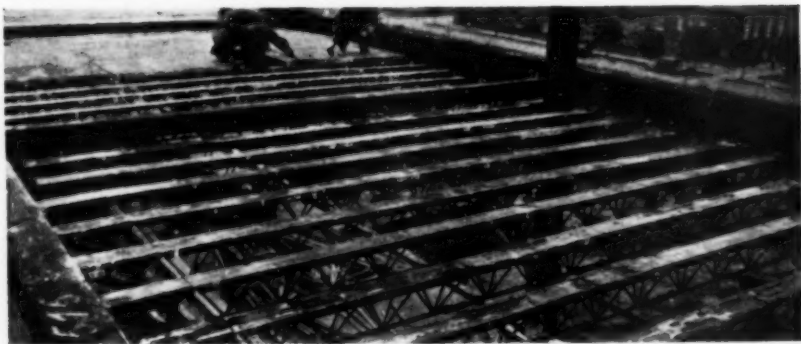
### Adjustable Beams for Supporting Centering.

A NEW type of adjustable steel beam for supporting centering for concrete floors and roofs is illustrated in *Figs. 1* and 2. Each beam (*Fig. 1*) comprises one or more short lattice members and two end bearers. The lattice members are of three lengths, namely 2 ft. 0½ in., 3 ft. 1 in., and 4 ft. 1¼ in. The end bearers are

the top flange and by turnbuckles on the tie-rods. Tightening the turnbuckles enables an upward camber to be formed on the beam so that, when the weight of the centering and wet concrete and constructional loads is imposed, the beams straighten and a flat soffit is obtained.



**Fig. 1.**—Adjustable Steel Support for Centering.



**Fig. 2.**—Fixing Centering Plates on Supports.

adjustable and are of two lengths, namely 1 ft. 7½ in. to 2 ft. 1 in., and 2 ft. 0½ in. to 2 ft. 9¼ in. A beam of any length up to about 27 ft. can be made up by combining members of various lengths, final adjustment of the length being made by the sliding straps on the end bearers. The top flange of the members is an inverted pressed-steel channel generally 6 in. wide. The bottom boom of the lattice members is a steel tie-rod. The members are connected by butt-joints in

*Fig. 2* shows these beams bearing on a structural steel frame and supporting steel centre plates. The beams can also be used with wooden sheeting and for the temporary support of hollow clay-tile floors. The weight of the beams is about 25 lb. per yard. Tests made in Germany show that the safe moment of resistance of the beams is about 39 tons-inches and the safe load on a standard end bearer is about 1 ton. The beams are supplied by Blaw-Knox, Ltd.

## MISCELLANEOUS ADVERTISEMENTS.

*Situations Wanted, 3d. a word: minimum 7s. 6d. Situations Vacant, 4d. a word: minimum 10s. Other miscellaneous advertisements, 4d. a word: 10s. minimum. Box number 1s. extra. The engagement of persons answering these advertisements is subject to the Notification of Vacancies Order, 1952.*

**Advertisements must reach this office by the 23rd of the month preceding publication.**

## SITUATIONS VACANT.

**SITUATIONS VACANT.** Reinforced concrete designers wanted for Southern Rhodesia and Union of South Africa. Candidates should have had at least 5 years' experience of competitive designing. Free passages. Salary according to experience and qualifications. Details in confidence to Box R13, c/o 95 Bishopsgate, London, E.C.2.

**SITUATIONS VACANT.** Civil engineer with first-class experience in design of heavy foundations and all types of reinforced concrete structures required for senior appointment with consulting engineers in Newcastle-upon-Tyne area. Applications are also invited for several posts for designer-draftsmen of similar works. Salaries commensurate with qualifications and experience. Apply, giving particulars of age, experience, and salary required, to Box 2545, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

**SITUATIONS VACANT.** The Trussed Concrete Steel Co. Ltd., Truscon House, 35-41 Lower Marsh, London, S.E.1, require additional staff in their London and Manchester design offices: (a) Designer-Draftsmen (age 25 or over), (b) Detailer-Draftsmen (age 20 or over). Previous good experience in reinforced concrete drawing office is important. Five-day week and pension scheme. Apply in writing to the above address giving full particulars of age, education, and previous employment.

**SITUATION VACANT.** Deputy to chief engineer in Manchester office of reinforced concrete specialists. Must be competent competitive designer, and capable of effective supervision of drawing office staff. Address applications in writing stating age, salary required, and particulars of career to date, in confidence, to Box 2546, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

**SITUATION VACANT.** Civil engineer (qualified), with practical experience of reinforced concrete construction and design, required by old-established British firm in Pakistan. Terms—three years' agreement, free passage, and salary up to 2,000 Pakistan rupees (equivalent £216) per month according to experience. Single man age 30/35 preferred. Apply, stating full details, to Box 2547, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

**SITUATION VACANT.** Water engineer required to design water supply schemes for North Borneo, including pumping, treatment, and distribution. The projects will be prepared in Singapore, and it is probable that the engineer appointed will be asked to supervise construction in Borneo. Please write to Box AP/2, c/o 95 Bishopsgate, London, E.C.2, for further information, and give details of career.

**SITUATIONS VACANT.** Reinforced concrete designers and detailers. Simon-Carves, Ltd., require reinforced concrete designers and detailers for industrial work. Excellent working conditions, and good scope. A pension fund and D.O. bonus scheme are in operation. Ministry of Labour permission will be necessary before engagement. Applications should be sent to Staff and Training Division, PERSONNEL DEPT. (Ref. Z.29), SIMON-CARVES, LTD., Cheadle Heath, Stockport.

**SITUATION VACANT.** Reinforced concrete. Deputy required to head of design department of well-known company of reinforced concrete specialists. Applicants must be University graduates or equivalent and/or corporate members of Institution of Civil or Structural Engineers. Administrative ability and first-class experience in design of all kinds of reinforced concrete structures essential. Preferred age 35/45. Write, giving age, education, qualifications, experience, and salary, to Box C.E. 121, at 191 Gresham Street, London, E.C.2.

**SITUATIONS VACANT.** Two structural draughtsmen with experience in reinforced concrete detailing required in London office of Norman & Dawbarn, architects and consulting engineers, 5 Gower Street, London, W.C.1. Reply stating age, experience, and salary required.

**SITUATIONS VACANT.** Architectural assistants. Simon-Carves, Ltd., have several vacancies for architectural assistants interested in reinforced concrete industrial structures. The main fields covered are coal preparation plant, coke ovens, chemical plant, and power stations. The work offers excellent experience and scope. A pension fund and D.O. bonus scheme are in operation. Ministry of Labour permission will be necessary before engagement. Applications should be sent to Staff and Training Division, PERSONNEL DEPT. (Ref. Z.B.36), SIMON-CARVES, LTD., Cheadle Heath, Stockport.

## NORTH THAMES GAS BOARD.

There are vacancies in the Chief Engineer's department for the following draughtsmen: (i) WESTMINSTER, S.W.1, experienced in any of the following: Coal carbonising plant, by-products plant, steel structures, pipe layouts, or materials handling plant. (ii) BROMLEY-BY-BOW, E.3, preferably experienced in the maintenance of gas plant and conversant with the design of steel structures and the layout of buildings. Starting salary, depending on age and qualifications, will be within the range £595-£725 per annum, and the appointments will be of a permanent nature after a probationary period. Pension arrangements will be discussed with short-list candidates. Applications, giving age and full particulars, should be sent to the Staff Controller, North Thames Gas Board, 30 Kensington Church Street, London, W.8, quoting reference 666/26, to reach him not later than 10 days after the publication of this advertisement.

**SITUATION VACANT.** Reinforced concrete designer required for Westminster office of civil engineering contractors. Applicants must have experience in competitive designs of industrial buildings, foundations, and marine structures. Apply stating age, experience, and salary required. Box 2549, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

**SITUATIONS VACANT.** The British Reinforced Concrete Engineering Co., Ltd., require several qualified designers with specialist experience for their Stafford, London, Bristol, Glasgow, and Newcastle-upon-Tyne offices. Five-day week, and staff pension scheme. Apply to B.R.C. ENGINEERING CO., LTD., Stafford.

**SITUATION VACANT.** Senior civil engineering draughtsman required in a large London concern. Candidates should have recent practical experience in design, construction, and detailing of reinforced concrete industrial buildings, structures and foundations, and some knowledge of structural steel work design. A good knowledge of structural theory is essential. Write, stating age, full details of qualifications, and previous experience (with dates), and salary required, quoting this paper, to Box No. 2550, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1. Original testimonials should NOT be forwarded. Closing date, 26 May, 1952.

**SITUATION VACANT.** The Trussed Concrete Steel Co., Ltd., require an engineer for site inspection of the reinforced concrete work carried out by contractors to the Company's designs. Applicants should have held responsible positions as resident engineers or agents for reinforced concrete constructional work. Visits to sites in all parts of the country will be entailed. Some design experience is desirable. Write, giving details of age, experience, and salary required, to the SECRETARY, THE TRUSSED CONCRETE STEEL CO., LTD., Truscon House, 35/41 Lower Marsh, London, S.E.1.

(Continued on page lii.)

## MISCELLANEOUS ADVERTISEMENTS.

(Continued from page liii.)

IMPERIAL COLLEGE OF SCIENCE  
AND TECHNOLOGYDEPARTMENT OF CIVIL ENGINEERING  
BURSARIES IN CONCRETE TECHNOLOGY

NOTICE IS HEREBY GIVEN that the election to Bursaries in Concrete Technology tenable as from October, 1952, will take place in June, 1952.

Candidates must hold a degree in engineering at the time of taking up the award, and must also have a good knowledge of the theory of structures.

Bursaries are of the value of £350 per annum, out of which the College Tuition Fee has to be paid; the amount may be increased to £450 for those with industrial experience. In addition, 1 or 2 Senior Bursaries of £600 per annum may be awarded to outstanding men with a minimum of 3 years' experience in industry.

The course will be postgraduate and Bursars who successfully complete the course will be eligible for the award of the Diploma of the Imperial College (D.I.C.).

Applications must be received on or before June 1st, 1952, by the DEPUTY REGISTRAR, CITY AND GUILDS COLLEGE, Exhibition Road, London, S.W.7, who will, on written request, send full information and application forms.

**SITUATION VACANT.** Reinforced concrete detailer required, with 4 to 5 years' experience, by consulting civil engineers. Chiefly water-containing structures. Five-day week; pension scheme. Salary according to experience. Write, giving age, etc., education, training and experience in chronological tabular form. Box 2551, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

**SITUATION VACANT.** Qualified civil engineer is required by British firm of civil engineers and contractors operating in Malaya and Borneo as assistant to the contractors' manager. Previous experience as contractors' agent or sub-agent on works of some magnitude is essential. Age indication 35 to 30 years. Initial agreement for three years. Write with full particulars, personal and professional, to Box AP/136, c/o 95 Bishopsgate, London, E.C.2.

**SITUATION VACANT.** Trollope and Colls, Ltd., require immediately site engineer for concrete control. Must have experience of sampling and testing of aggregates, moisture content, and concrete mix design and control. Write Chief Engineer, 41 Great Queen Street, London, W.C.2.

**SITUATION VACANT.** Designing structural draughtsman required by large South London builders specialising in all types of housing work. Preferably member of Institution of Structural Engineers. Commencing salary up to £650 per annum according to experience. Apply Wates, Ltd., 1258-60 London Road, London, S.W.16.

## FOR SALE.

**FOR SALE.** Lister 10/7 concrete mixer for sale. F. J. EDWARDS, LTD., 359 Euston Road, London, N.W.1. EUSTON 468L.

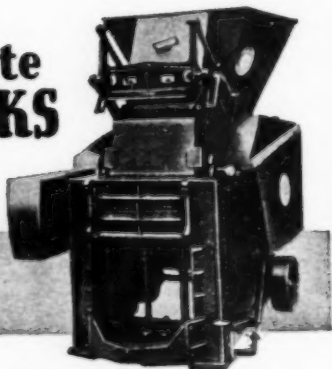
**FOR SALE.** Steel-angle fencing stakes, 54 in. by 1½ in. by 1½ in. by 14-gauge. Holes at 6-in. intervals; pointed and painted, at 2s. each, 50 lots; 1s. 11d. each, 100 lots; 1s. 10d. each, 1,000 lots; carriage paid. Other sizes available on request. E. STEPHENS & SON, LTD., 58/64 Bath Street, London, E.C.1.

## EXCHANGE.

**EXCHANGE.** 3 tons mild steel reinforcing rods, 1 in. diameter or smaller, in exchange for equal weights of ½ in. diameter "Isteg" reinforcing equivalent to 1½ in. diameter plain round. Apply RIBAR, LTD., Higher Swan Lane, Bolton.

# High-pressure Production of Concrete BLOCKS

**TRIANCO**  
No. K'2 Type  
BLOCK MAKING MACHINE  
Power Operated  
Fully Automatic



This machine is specifically designed for the mass production of SOLID BLOCKS and is capable of producing 300 blocks per hour, which are jolted, compressed and extruded automatically. Fitments are also available for the manufacture of hollow blocks.

DELIVERY FROM STOCK

Full specification will be sent on application

# TRIANCO

BLOCK-MAKING MACHINES

**TRIANCO LIMITED**  
IMBER COURT, EAST MOLESEY, SURREY  
Telephone: EMBerbrook 3300





**ALPHA CEMENT LTD**

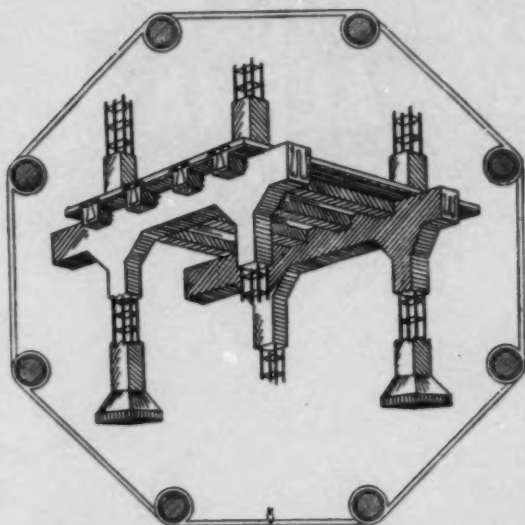
**PORTLAND HOUSE TOTHILL STREET**

**LONDON, S.W.1.**

*Telephone - Abbey 3456.*

# FRED MITCHELL & SON LIMITED

*Building & Civil Engineering Contractors*



*Bridge, Road and Rail Construction,  
Cooling Towers, Silos & Commercial Buildings,  
Excavations, Foundations, Piling,  
Dock and Sea Defence Work,  
Water Mains, Sewerage, Reservoirs etc.*

**RIVER PLACE · CITY ROAD · MANCHESTER**

Telephone: Central 7018-9

AND

**57 VICTORIA STREET · WESTMINSTER · LONDON S.W.1**

Telephone: Abbey 7103